The Mining Journal

London, August 25, 1961

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Vol. 257 No. 6575

Established 1835

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Published each Friday by
THE MINING JOURNAL LTD.

Directors
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C. A. Baliol Scott R. A. Ellefsen

15 WILSON STREET,
LONDON, E.C.2

Telegraphic Tutwork, London, E.C.2
Telephone MONarch 2567 (3 lines)

Annual Subscription £3 15s. Single copy ninepence

Steel in India's Economic Planning

ACCORDING to the final report of India's Third Five-Year Plan, the overall targets proposed for the iron and steel industry are 10,200,000 tons of steel ingot capacity and 1,500,000 tons of pig iron for sale. New developments included in the Third Plan comprise the expansion of the Bhilai, Durgapur and Rourkela steel plants and of the Mysore Iron and Steel Works, the establishment of a new steel plant at Bokaro, and a project for a pig iron plant based on the use of coke from the Neiveli lignite. The private sector's share in the steel target is 3,200,000 ingot tons.

The capacity of the Bhilai steel plant is to be extended to 2,500,000 ingot tons, Rourkela to 1,800,000 tons, and Durgapur to 1,600,000 tons. At present all three plants have an ingot capacity of 1,000,000 t.p.a. A few days ago it was reported that an agreement on the expansion of the Durgapur steel works by 600,000 tons was expected to be signed between India and Britain very shortly. Under the agreement British credit will be available only for the purchase of equipment from the U.K.

It is interesting to note that the project work on the fourth steel plant at Bokaro was entrusted to an Indian firm. According to Sardar Swaran Singh, Minister for Steel, Mines and Fuel, the preliminary report submitted by the Indian consultants has been well received by experts abroad. Bokaro is being planned for a capacity of 2,000,000 ingot tons, but in the first phase it is proposed to install facilities for the production of 1,000,000 tons. The possibility of American assistance for Bokaro has been mooted, but no final decisions have yet emerged.

In view of all the problems involved, the four-fold increase in steel production during the past five years, when output was expanded from 1,578,000 to 6,000,000 tons, was a remarkable achievement. Compared with some other less developed countries, India was slow to appreciate that the growth of agriculture and the development of human resources are critically dependent on heavy industry, which in turn depends on steel. At the beginning of the First Plan future demand for steel was sadly underestimated, proposals for expanding its production being limited to half-hearted planning for a 500,000 ton plant. This failure to appreciate and provide for future needs contributed in no small measure to the severe foreign exchange crisis which arose in the Second Plan period. The urgency of expanding steel production appears to have been better appreciated in China, which is faced with similar development problems to those of India. In the last eight years steel output in China has multiplied more than twelve-fold.

Yet rapid industrialization as a solution to the problems presented by low living standards and a rapidly growing population was advocated by Sir M. Visvesvaraya, a founder of the Mysore Iron and Steel Works at Bhadravati and a former director of the Tata Iron and Steel Co., in his book, "Planned Economy for India", which was published as long ago as 1934.

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In a paper delivered to the Institution of Engineers (India) as the Fourth Sir Visvesvaraya Lecture *(Steel in India—Economic and Technological Possibilities, J. Inst. Eng. (India), XLI, 8, Part I, April 1961)*, Dr. M. N. Dastur claims that India is well endowed with the raw materials and other conditions necessary to produce the lowest cost steel in the world, and discusses the development of the industry in the light of available resources and future needs. A recent study by Dr. Dastur's colleagues estimated India's steel requirements, to meet the various production and construction targets set out in the Third Plan, at about 12,000,000 ingot tons by 1965-66. By that date, however, India's population will have risen to 480,000,000. As the paper points out, an ingot steel demand of 12,000,000 ingot tons (which exceeds the production target by some 2,000,000 tons) would thus be equivalent to a consumption of only 25 kg. a head, as compared with the current *per capita* consumption of 40-70 kg. in many Latin American countries, which also have underdeveloped, largely agricultural economies.

Looking further ahead, the study foresees requirements of 19,000,000 ingot tons by 1970, increasing to 28,000,000 tons by 1975 and a probable 110,000,000 tons by the end of the century, by which time it is expected that the population will have risen to 840,000,000 and *per capita* consumption to 130 kg. In Dr. Dastur's view this steel will have to come mainly from large complexes (of 10,000,000-12,000,000 ingot tons capacity each), the balance being met from a large number of widely dispersed smaller plants to meet regional demands.

Practically all the existing steel capacity has been installed in the Bengal-Bihar-Orissa-Madhya Pradesh area, which possess the largest reserves of iron ore as well as India's only reserves of coking coal. This area has sufficient reserves to support the expansion of the existing plants and initiation of the large new steelworks, of which at least three will have to be set up in each of the succeeding Plan periods.

Completion of the heavy machine building plant at Ranchi is expected to provide the main equipment for metallurgical industries. It will have an annual output of 80,000 tons of equipment which will enable it to meet the bulk of the requirements for establishing a million-ton steel plant each year. Similarly, the development of other machine building industries envisaged in the Third Plan should enable India to rely to a progressively greater extent upon indigenously produced capital equipment.

The expansion of steel capacity calls for urgent attention to the continuity of raw material supplies. While India's iron ore reserves are very large, the present supply of coal and flux-grade limestone is critical and allows no ground for complacency. Known resources of iron ore at an estimated 20,000,000,000 tons are regarded as sufficient for 100 years. On the other hand, reserves of coking coal (washed) at 1,600,000,000 tons are sufficient for only 35 years, while those of flux limestone (up to 6 per cent insolubles) at 140,000,000 tons will last for only 15 years.

The Second Plan target of 60,000,000 tons coal production capacity is likely to be reached, although supplies may be hampered by transport bottle-necks, but to achieve the 97,000,000 tons coal target by 1965-66 it will be essential to open a greater number of new mines and also of new washeries.

During the last 20 years the average ash content of Indian coal has increased from about 16 to over 24 per cent and it is likely to go up further with larger future production by mechanized bulk mining methods. The inferior quality of the majority of the coking coals forces the Indian blast furnace operator to accept coke with 22-23 per cent ash, which is twice the proportion of ash in coke used by most steelworks in other countries. It will, therefore, be essential to wash practically all Indian coal supplies to the steel plants. The poor planning and consequent delays in setting up washeries in the Second Plan has contributed substantially to the production bottle-necks at steel plants. Washery capacity to produce about 9,000,000 tons of clean coal should have been ready by 1960-61, but only one-half of this capacity is in operation. Even after all these washeries are completed, there will be a severe shortage of washed coal in the Third Plan, unless detailed coal blending and washing investigations are immediately initiated, new washeries started, and existing ones expanded to meet the 1965 requirements of about 18,000,000 tons of clean coal.

Aside from this problem, the more extensive use of a higher proportion of high volatile coals in the blend at Indian steelworks is desirable, in order that the limited resources of low volatile coking coal may be conserved. Another objective, as advocated by Dastur, is reduction of the coke rate per ton of iron in Indian blast furnaces to about 600 kg. from the present figure of 900 kg.

On the subject of manganese, the paper deprecates the widespread belief that India's reserves of high-grade ore are practically inexhaustible and suggests that, for the magnitude of steel production visualized, the better grade ores should be conserved by a drastic reduction in the present rate of export.

The raw materials outlook is likely to be improved by new discoveries and large-scale beneficiation. Accordingly it is considered imperative that an intensified and co-ordinated long-term geological investigation programme be initiated, which would call for a large increase in the country's present strength of geologists.

Such problems as high insolubles in the fluxes, high ash in coke, unfavourable aluminium-silica in some iron ores are likely to be solved by proper planning and more intensive use of available technical facilities, together with new developments in the metallurgical field.

As regards the human implications of India's steel expansion programme, a reorganization of the management structure, giving it greater administrative and financial autonomy, is regarded as essential to the successful operation of the new State undertakings, as is the appointment of technical staff with the requisite plant experience in top management positions. Facilities for specialized technical education and for practical training require to be greatly expanded.

While the present steel expansion programme does not include any steel for export, Dastur urges that serious consideration be given to the export of, say, 2,000,000 tons of steel by 1970. At this rate, he suggests, steel could become the largest single earner of foreign exchange so vitally required for further development.

AUSTRALIA'S SEARCH FOR EXPORTABLE ORE

With the lifting of the embargo on the export of iron ore from Australia, the search for exportable ore is expanding amongst the smaller deposits. Export is prohibited from a number of high grade, large tonnage deposits which are reserved for Australian requirements, but there are numerous deposits, ranging in tonnage from a possible 1,000,000 tons to as much as 30,000,000 tons, irrespective of a grade acceptable to overseas smelters.

So far, Western Australian deposits have been in the forefront of the search, and the State Government has granted 27 temporary reserves over occurrences which on development, or at least on more intensive prospecting, may be

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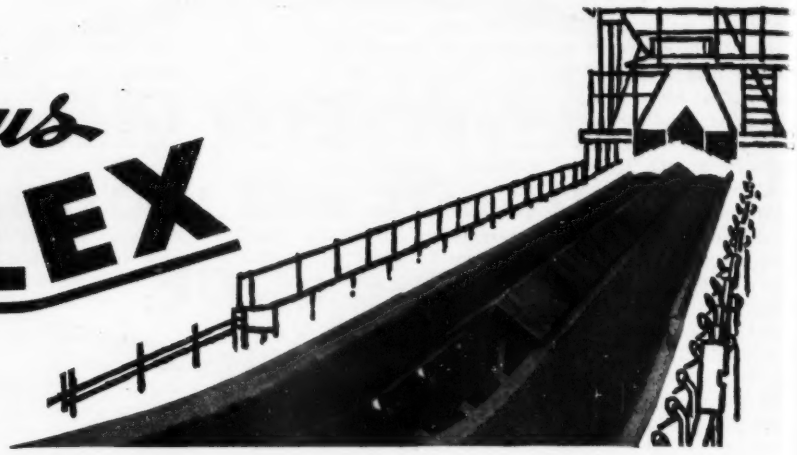

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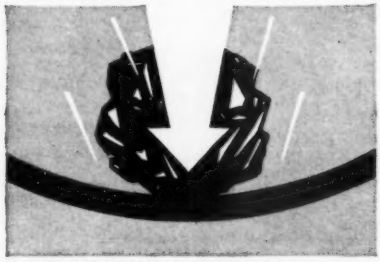

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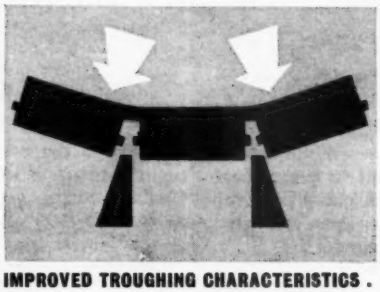

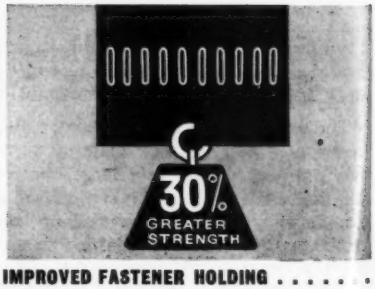

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found to contain sufficient ore of suitable grade to be saleable. Preparations are advancing toward export, and the big problem of land transport and harbour facilities at certain Western Australian localities is under consideration. Conditions covering these reservations are strict. Japanese interests appear to be impressed by the overall indicated tonnage of the deposits and there is considerable local optimism in the building up of a substantial export trade. The largest tonnage so far approved for export from one deposit is 30,000,000 tons and it is doubtful if any other single deposit will approach this tonnage.

Interest in iron ore prospects has now moved to South Australia and private drilling and sampling has been commenced near Olary, and Tarcoola, but work is necessary to confirm preliminary ideas of potential tonnage. The export ban will remain strictly imposed on the Middleback Ranges. Indicated tonnages in available South Australian occurrences appear to approximate 500,000 tons, irrespective of grade, and the deposits are close to railways.

Tasmania is pressing on with the Savage River deposits in the north-west and a trial shipment of ore has been sent to the United States. Apart from the inaccessibility of the deposits, an obstacle to early utilisation is a titanium content. The Broken Hill Proprietary Co. is quietly active in the examination and proving of large tonnage deposits to supply the demands of the greatly expanding steel requirements and production resources. Amongst the interested exploration companies are Consolidated Goldfields (Australia) Pty. Ltd., Cyprus Mines Corporation of Los Angeles, U.S.A., and Utah Mining and Construction Co. Geologists are being flown to Australia from the U.K. and U.S.A. (See *The Mining Journal*, July 28, 1961, p.103.)

FUTURE OF THE KOLAR MINES

The Government of India has decided in principle to take over the Kolar gold mines from the Mysore Government. Details relating to the amount of compensation to be paid to the Mysore Government and the machinery to be set up to operate the mining undertakings are now being worked out.

Plans are expected to be completed in the next two or three months for the intensive and extensive exploitation of the mines. It is understood the Central Government has worked out plans to develop and exploit all the five mines in the Kolar area, some of which had been closed down by the Mysore Government for want of finance and also on the ground that their working was uneconomic. The mining engineers of the Centre do not share this view. They appear to feel that the five mines need further careful study and exploitation with the help of the latest mining devices and equipment. A Union Government-owned undertaking, charged with the responsibility of gold-mining operations, would be in a better position to find the necessary finance, equipment and technical know-how to operate these mines.

The Mysore Government at present operates these mines with Central assistance and the quantum of such assistance has been the subject of a prolonged dispute between the Union Finance Ministry and the State Government.

Mysore had been asking the Centre to continue its financial assistance or allow it to sell the gold directly in the Indian market where it will fetch a price of Rs.130 per tola, instead of the international price of Rs.63. The Union Government did not agree to this and, pending a settlement of this issue, the Mysore Government has expressed inability to develop these mines.

The capital investment in the mines is estimated at Rs.180 lakhs and the number of workers employed exceeds 20,000.

Malayan Digest

MUCH mineral wealth is being lost because of inefficient mining and mineral dressing techniques according to a recent statement by Mr. A. W. Burne, the acting Chief Inspector of Mines, Federation of Malaya. He said that inefficient mine working left a part of the ore in the tailings. In an attempt to minimise such losses the Research Division of the Department of Mines, situated in Ipoh, is intensifying its investigations into the methods of extraction and treatment in use, particularly on small mines which contribute a substantial portion of Malaya's total tin output.

The research Division has already achieved a good measure of success in improving recovery rates through its experiments with hydro-cyclones. These experiments are continuing, but hydro-cyclones and jigs already installed in a fair number of small mines with advice and adaptation by the Research Division have resulted in improved recoveries by as much as 50 per cent.

The Division has for some time suffered from a shortage of research officers. The present technical staff consists of three only — the chief research officer, a senior research officer and one research engineer. The Australian Government has lent a mineral dressing expert, under the Colombo Plan, and another is expected from Australia later this year.

The laboratories at the Division's headquarters in Ipoh are to be expanded, to cope with the additional work which the intensified programme will entail. This is not confined to tin alone but is also concerned with the rapidly growing iron ore industry.

Tin Buffer Stock Repayment

The Treasury announced on August 12 that tin mines in Malaya would receive about 16 per cent profit on their contributions to the first Buffer Stock under the International Tin Agreement which has been liquidated. The actual contributions totalling $M55,500,000 are now in course of being repaid to the miners, and distribution of the additional $M9,000,000 representing profit, will commence shortly.

Many small miners had been looking forward to the return of their contributions to the first Buffer Stock to provide them with the capital to open new mines or re-open old mines. The imposition by the Government of the Federation of Malaya of a levy of $M36 on every picul of tin concentrates delivered to the smelters as from August 1, as a contribution towards repayment of the bank loan raised by the Government to pay Malaya's share of the contributions to the second Buffer Stock, has come as a severe blow to their hopes.

The rate of contribution has been gazetted for the period August 1 to 31. As this rate is related to the Singapore tin metal price, with a Ministerial discretion to reduce the rate of the levy, it may be expected that unless such discretion is exercised, the rate of contribution by the miners will be increased as from September 1.

Marginal producers, in which category are a high proportion of the small miners, say that the $M36 a picul payment to Government makes all the difference in being able to obtain an income from working their mines and being out of pocket by so doing.

In these circumstances most of them have given up their ideas of re-opening marginal mines, preferring to wait for a lower contribution rate and higher market price. It would

therefore seem that no additional production can be looked for from the opening or re-opening of small marginal mines for the present, at any rate.

Raub Gold in Difficulties

Malaya's only sizeable gold mine is likely to cease operations in the near future. Raub Australian Gold Mining Co. Ltd. has notified the Federation of Malaya Government's Industrial Rehabilitation Finance Board and the Mercantile Bank that, after a study of the present position at the mine and all relevant factors, it cannot carry on any longer.

After the last World War the company obtained a loan from the Mercantile Bank Ltd., guaranteed by the Malayan Government, for the purpose of rehabilitation. This loan carries interest at 3 per cent per annum and was agreed to be repayable in instalments at the rate of £A22,503 annually. According to the last published accounts, £A135,000 was still outstanding at March 31, 1960.

At the company's annual general meeting in Brisbane on January 1, 1961, Mr. M. D. Davies, the chairman and managing director, announced that there was insufficient cash to meet the instalment on the loan then due. He said that he had been assured by the Federation Government that it would approach the bank, which holds a debenture over the company's assets. He also stated that negotiations were taking place to raise the necessary money.

The chairman further said that fresh lodes had been discovered and prospects appeared to be better than for months past, but six months later a progress report disclosed that the lode reserves had not come up to expectations and the situation of the company had become disturbing.

The mine was founded in 1889 by an Australian engineer named Sefton, and the present company was registered in Brisbane in 1892. The issued capital is £A200,000 all fully paid. Up to 1942, the company was one of Malaya's best dividend payers, but since then it has not reached the dividend lists. The first post-war profit was £A2,342 for the year to March 31, 1960. For that year, from 57,052 tons treated, a yield of 17,821 ozs. fine gold was obtained at mining and treatment costs of $M18.4 a ton.

The mine at Raub in west Pahang, on which the lease held from the Government does not expire until 1997, comprises a four-mile-long ore-body served by four main shafts and six intermediate shafts, a 240 tons a day ball mill, a 20-stamp mill and cyanide, roaster and scheelite treatment plants. Power supplies are obtained from the company's own hydro-electric plant at Sempan and by diesel generators. Ore reserves at March 26, 1960, were reported to be 35,710 tons, of a 5.5 dwts. a ton grade.

All the gold produced by the company is sold locally at a price slightly above the market price, and unless the Federation Government intervenes to save the mine, about $M2,000,000 worth of gold will have to be imported annually to replace the supply hitherto obtained from Raub.

Raub Gold represents the oldest business relationship between Australia and Malaya.

Iron Ore Production

A joint Malayan-Japanese team is surveying the west coast of Perak to find a site for an iron and steel mill. In April of this year, Pahang became the seventh State in the Federation of Malaya to be producing iron ore. The mine then opened produced 41,084 tons up to the end of June. The Bukit Ibam mine will add materially to the Federation's annual production of iron ore, at present running at around 7,000,000 tons a year, most of which goes to Japan.

Isotopes in Mining—II

Radioisotopes in

RADIOISOTOPES have applications in many phases of mining, for example :

1. *Radioisotope sensing devices :* on continuous mining machines to maintain automatically a predetermined distance of cutting heads from the roof or floor rock. The latest issue of *Mining Congress Journal* contains the translation of a Russian article which concludes, on the basis of field tests, that the scattered gamma-radiation effect may be used for the control of automatic mining machinery[2]. Development tests have also been under way in England.

The same nuclear techniques may also be used to give warning or to stop a mining machine before it runs into a fault, pinch or want in a bedded mineral deposit. Such developments permit remote control of mining machinery—an important safety advantage.

2. *Use of explosives :* Radioisotopes may be used to study the performance of various shooting patterns, and to detect unexploded blasting caps or explosives in the product.

3. *In-mine handling of product :* Radioisotope devices can be used to control automatically the level of loading mine cars, hoppers, skip hoists, conveyor belts, etc. Also, mine cars may be counted, weighed and shunted according to point of origin, or ore quality. In hydraulic mining, the proportion of water and the rate of product flow may be measured. All of these can be done without contacting the materials.

4. *Mine floor and roof-support :* Nuclear methods may be used to monitor the moisture content of clay mine floors to avoid heaving, or the miring of heavy equipment in mud. Another use is to check road conditions for rail haulage in and around mines, including the condition of track foundation, the compaction of ballast and the condition of ties. The soundness of wooden posts, crossbeam and timbers used for mine roof support or structural purposes can be checked. The flow patterns of injected roof cementing materials or the thickness of surface coatings can be inspected.

5. *Checking dust and gas hazards :* Radioisotope techniques can be used to study the performance of mine ventilating systems, including air distribution, flow and leakage; and the dilution of gases and respirable dusts.

6. *Radioisotope-excited luminous sources :* These include luminous markers, signal lamps, and portable lights which will function for years without external power or fuel source.

7. *Mine-water problems :* Radioactivity techniques can be used to measure corrosion, erosion and deposits in mine-drainage lines while they are in use. They can also be used to determine the sources of water entering mine workings, and the fate of mine effluents.

Preparation Processes

Probably the most extensive use of radioisotope instruments in the mining industry to date, has been in connection with preparation processes.

1. *Process measurements and controls :* Nuclear techniques are used to record and control the density, viscosity, composition and regeneration of heavy-media cleaning baths. They control the density of slurries and pulps fed

...ing Operations

This paper by H. J. Rose, Pittsburgh consultant, was presented at a conference on Radioisotopes in the Mining Industry held at Denver during April 13-14 this year and sponsored by the American Mining Congress and the Colorado School of Mines Research Foundation, Inc., in co-operation with the Office of Isotopes Development of the Atomic Energy Commission. The paper, of which the second of two instalments appears herewith, is presented in abridged form

to cleaning plants, thickeners, filters, and of underflows, overflows, etc., thus permitting optimum performance. In other applications, meters record, totalize and control the mass flow rates of slurries, or of their liquid or solid content. Such techniques also help alleviate water shortages and stream pollution problems.

Radioactive techniques can also be used to determine the quality of products being handled to permit automatic shunting to appropriate bins, and controlled blending of feeds or products. Liquid levels are monitored and automatically controlled in plant process equipment. Variables can be continuously controlled such as the moisture, amount of binder and density when pelletizing fines.

2. *Equipment development:* There are endless opportunities for the use of radioisotope techniques in studying and improving the performance of mineral preparation methods and equipment design. For example, the movement of individual particles or particular fractions can be studied in jigging operations or heavy-media cleaning processes. Another application is the continuous external monitoring of conditions in a fluidized solids system.

The degree of automatic operation obtainable with radioisotope control, is shown by an anthracite cleaning plant in Pennsylvania. This plant receives, processes, sizes and loads about 600 tons per single-shift day, with only one man in the entire plant. The quality and uniformity of the anthracite shipped was improved considerably by the adoption of gamma-ray density control of the dense-medium cleaning bath.

Storage, Weighing, Handling, and Transportation

Radioisotopes techniques are in use to:

1. Monitor storage in bins, for example to control maximum and minimum bin levels, to measure bin contents, and to give warning of interruptions in flow from bins.

2. Detect early stage of spontaneous combustion or other overheating, by a radioisotope-activated fire alarm.

3. Measure density and moisture content of bulk materials being handled or stored.

4. Weigh material in motion. Weights can be determined of products on conveyors, or moving trucks or trains, or granular materials falling through pipes or chutes.

5. Automatically identify, count, and shunt moving trucks, railroad cars, etc.

6. Monitor the pipeline transport of solids, for example to measure flow, composition, segregation and erosion.

Radioactivity techniques in use include:

1. Gamma-ray radiography for the inspection of weldments and castings.

2. Autoradiography as an inspection and research tool to develop more durable machine parts.

3. Measuring wear includes in-place on-stream measurement of erosion, corrosion and wear; the evaluation of lubricants for mining applications; and expedited evaluation of the resistance to wear of drill tips, cutter bits, bucket teeth, pulverizer parts, etc.

The examples mentioned have related chiefly to measurement and control operations using existing radioisotope equipment on a routine operating basis.

Time limitations prevent my giving examples of the endless uses of radioisotope techniques for cheaper and better sampling, analysis and testing; for research on mining and preparation; for the control of air and stream pollution in the mining industries and for extending the countless uses of mineral products. It may be truly said that the potential uses of radioisotopes for such purposes is limited only by the imagination and the experience of the technical personnel involved and by the nuclear facilities and budget at their disposal. Such activities can be handled readily and safely by qualified personnel if provided with suitable equipment and facilities.

Evaluation of Proposed Applications

In this 30 minute survey I have tried to give a general impression of the applications of radioisotopes to the mining industry. Other speakers will discuss some of these topics in much more detail and they will also mention additional uses. By the time that this conference is over, the mining operators present will have many ideas and many unanswered questions, as to ways in which radioactivity might be used to advantage by their company.

What will your next step be in converting these ideas into action? Perhaps your company has a nuclear research department which can help evaluate proposed radioisotope applications. Other companies may at present be interested in just one type of use, and will get in touch with suppliers of appropriate nuclear instruments.

However, some company representatives may find the ideas and accomplishments described at this conference to be so promising that they will recommend that their management authorize an exploratory survey. The purpose would be to decide how radioisotope techniques might be used to advantage in their company's operations.

Such surveys can best be made by nuclear consultants experienced in mining and other industrial aplications, working in co-operation with the technical staff of the mining company. In this way existing problems and needs of the company will get adequate attention, yet new approaches and opportunities will not be overlooked. In this connection, the previously mentioned checklist[2] of existing and potential applications of nuclear technology in the mining industries, should be of assistance.

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Mining in Southern Rhodesia

This survey is extracted from *The Mining Industry of Southern Rhodesia 1961*, a handsomely bound commemorative volume issued by the Southern Rhodesia Section of the Seventh Commonwealth Mining and Metallurgical Congress. Prepared primarily for the information of delegates, the book gives a comprehensive account of the occurrence of minerals and the mining and metallurgical processes adopted in Southern Rhodesia

EXTENSIVE mining, principally for gold, copper and iron, was carried out by the inhabitants of south Central Africa long before any European contact was made. The majority of the Colony's gold mines have been established on ancient workings and romantic speculation has sought to link Southern Rhodesia with the ancient Ophir of the Bible. Copper has been extensively worked in all parts of south Central Africa where deposits occur. The art of copper smelting and working was well understood. Iron mining was also a major industry and there appears to have been a considerable trade in the metal. Tin was also an early article of trade at Sofala, but if recovered in Southern Rhodesia was most likely won from eluvial workings of which all trace has now been lost.

Gold

Extravagant hopes raised by early reports influenced the policy of the British South Africa Co., whose first mining laws provided for mines to be worked only by companies in which the Company had to receive 50 per cent of the scrip. The gold was not present in the vast quantities anticipated, however, and the opening up of the mines was often in the hands of men with a very limited knowledge of mining. Many difficulties were encountered and the financial results were disappointing. The outcome was that the company altered the terms under which mines could be worked and permitted individuals and syndicates to mine on a small scale.

Thus began the era of the so-called "smallworker", who was to play a very important part in the development of the country. In 1938 there were some 1,548 properties in operation. An attempt was made to increase smallworking after the war with the formation of a Mining Settlement Scheme for returned ex-Servicemen. Due to the fixed price for gold and rising costs, however, this section of the industry has steadily declined and the total number of producers, including large mines, in 1959 had fallen to 204. The smallworking section of the industry has been of great benefit to the country and from the efforts of the smallworker several of the larger mines developed.

Smallworking is by no means finished, states the book, although in future it may exist in another form and be taken up by the more advanced Africans, who may, like the European prospector, prefer the freedom of this form of life to employment in industry in some town.

During 1959, 2,293,482 tons of ore were milled to produce 565,883 oz. of gold, an average grade of 4.93 dwt. per ton. The greater part of the production came from mines producing over 10,000 f. oz. per year. Methods of operation vary depending on the size and nature of the orebodies and the complexity or otherwise of the ore.

In order to assist the gold mining industry a roasting plant to treat refractory concentrates was set up by the government at Que Que. To this mines sell a wide variety of concentrates, which may be of iron pyrite, pyrrhotite, arsenopyrite or stibnite, or a combination of these. The roasting plant started operations in 1938 and up to the beginning of 1960 had treated 148,220 tons of concentrate for the recovery of 358,427 oz. of gold.

Crude arsenious oxide from the roasting of arsenical concentrate is precipitated in a Lodge Cottrell electrical-precipitation unit. It contains 70-80 per cent As_2O_3 and from 6 to 12 dwt. of gold per ton. This product is sold to African Explosives and Chemical Industries (Rhod.) Ltd., who refine it by resublimation for the manufacture of cattle dip. Output of arsenic at Que Que ranges from 100 to 300 t.p.a.

Although the operations of the roasting plant were initially to be on a no profit—no loss basis, it has been necessary for the government to subsidise the cost of operations as an aid to the industry.

Coal

A very considerable area of coking coal has been proved at Wankie where the present collieries are situated. Coal also occurs at Lubimbi on the Shangani River east of Wankie, where further reserves of good quality coal have been established, and at Sengwe some 60 miles N.E. of Lubimbi. A considerable amount of prospecting has been carried out in the eastern part of the basin, with the object of proving coal as near to the railway line at Hartley and Gatooma as possible, but with little success. In the Sabi-Limpopo area considerable exploration has been carried out near the Mkwasini and Sabi Rivers. This work has shown that the coals occur in basins, generally have high ash contents, and are much disturbed by dolerite dykes. Reserves of better quality coal have been proved in the Tuli coalfields N.W. of Beit Bridge, but lack of transport facilities prevents further development at present. More recently an extensive exploration programme has located extensive areas of coking coal near the confluence of the Bubye River with the Limpopo.

Despite the widespread occurrence of coal in the Colony, development and production has so far been confined to the Wankie area, the only producer being the Wankie Colliery Co. Ltd., whose collieries have played a vital part both in opening up Southern Rhodesia and in the development of the Northern Rhodesian Copperbelt. Even when the hydro-electric project at Kariba has been fully developed, Wankie coal will still be used as a source of thermal power.

Asbestos

Asbestos is now Southern Rhodesia's leading mineral in value of output. Production is solely confined to chrysotile. The largest deposits occur in the Shabani area, where they are lenticular in their workable sections and have been proved

915

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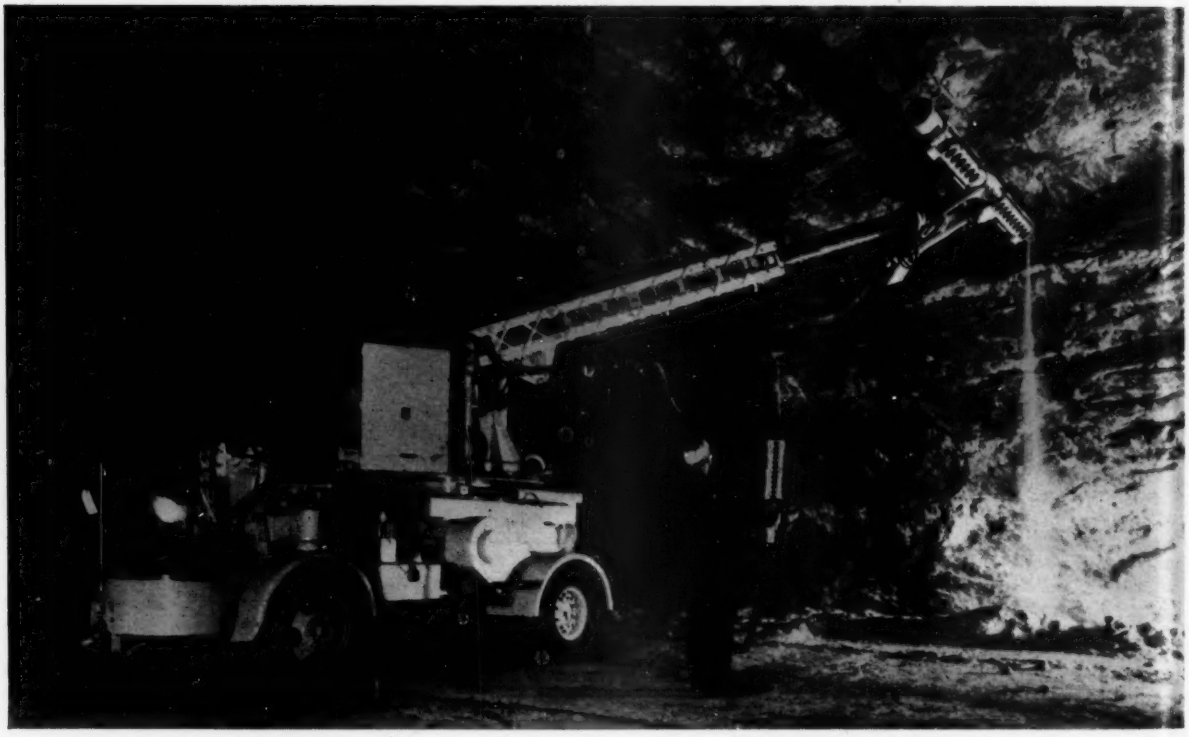
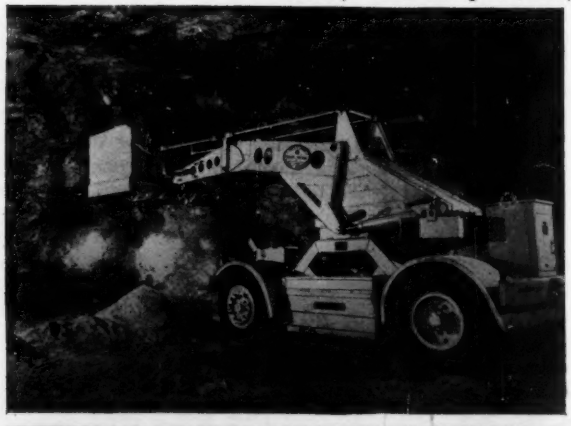


The Taylor Hurd mining drill, dust-free in operation, one-man controlled, drills in all directions from one position.



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to persist to considerable depth. Only rock containing more than 1 per cent of fibre is considered payable, the working sections at Shabani usually containing from 3 per cent upwards of recoverable fibre. The workable zones are large, that at the 170 section, Shabani mine, having a strike length of some 2,000 ft. and a width of 200 - 300 ft.

During 1959 production of asbestos in Southern Rhodesia was 119,699 tons (last year it rose to 133,963 tons), the principal producing mines being those under the control of Turner and Newall Ltd., which accounted for 67 per cent of the total production and 78 per cent of the total value of all asbestos produced. The remainder of the output was accounted for by the operations of 19 smaller mines. As much ore as possible is recovered by opencast methods.

The grades produced conform generally to the Canadian chrysotile asbestos classification or to special gradings used by the producers. The geographical situation of Southern Rhodesia, however, has retarded the development of shorts. In view of the increasing demands for well-prepared short fibres to meet the needs of expanding plastics industries, one company, Vanguard Asbestos Mines (Pvt.) Ltd., has been exploring the possibilities of this market for some years and has succeeded in placing such fibres on the world market in competition with the standard Canadian products.

Chrome

Southern Rhodesia possesses very considerable reserves of chrome ore and has been a major source of supply for the world's markets for the past 50 years. There are three distinct groups of deposits comprising: (1) massive lenticular bodies; (2) parallel seams; (3) eluvial deposits. By 1959 a total of 11,407,246 tons of ore had been produced from all sources.

From 1905 to 1950 the Selukwe mines, which belong to the first and most important group, were worked solely by Rhodesia Chrome Mines Ltd. and during this period they produced 6,459,529 tons of chrome ore, the bulk of which consisted of high grade metallurgical ore. In addition, smaller deposits of refractory ore have been mined. Despite the large tonnage extracted it is probable that very considerable reserves remain, and recent geological work and exploration continues to disclose new orebodies.

In the Mashaba area, west of Fort Victoria, bodies of chrome ore similar to those at Selukwe but smaller are found. The main producer is the Prince mine, which is worked by Rhodesia Chrome Mines Ltd. These deposits have been worked since 1927 and produced 200,272 tons of ore up to the end of 1959. The reserves are considerable.

With the opening up of the Lourenco Marques railway line more attention has been paid to prospecting in the southern part of the Colony. This has resulted in the discovery and opening up of a new chrome field in the southern portion of the Belingwe Native Reserve. Production from this field commenced in 1957. South of Nicholson a small mine, the Aer has been producing refractory chrome for some years.

The second group of deposits, consisting of parallel seams, occurs in the Great Dyke, where the chrome mineralization is in four composite complexes each having a remarkable layered structure. The seams below No. 3 are of metallurgical grade with an average Cr_2O_3 content of 48 per cent and a chromium to iron ratio of 2.8 to 1. These seams are amenable to beneficiation. They are usually narrow and vary in width from 5 to 6 in. The upper seams are usually of chemical grade. The Great Dyke contains the major reserve of chrome ore in Southern Rhodesia. Based on the calculated content of outcropping seams down to a vertical depth not exceeding 500 ft., its possible extent has been calculated at 189,315,000,000 s. tons of metallurgical and 354,453,000,000 s. tons of chemical refractory.

Apart from the chrome seams it has been determined that the country rock may contain up to 3 per cent of disseminated chromite by volume, and the concentration of this mineral in the soil may range from 3 to 35 per cent. Owing to the nature of the mineral and its fine grain size the ore is recovered from the soil by flotation methods. The concentrate produced is further cleaned by magnetic separation. The potential reserve of eluvial chrome is very considerable. The recovery of eluvial chrome was pioneered by Rhodesian Mining Enterprises (Pvt.) Ltd., which produced 40,000 tons in 1959. African Chrome Mines Ltd. has installed a plant in the same area.

The current production of the various grades of chrome ore in Southern Rhodesia at the rate of 600,000 t.p.a. is in the following proportions: Metallurgical grade 55 per cent; chemical grade 28 per cent; refractory ore 17 per cent.

Copper

In modern times the main production took place from 1914 to 1925, with limited further production from 1933 to 1935. From 1931, however, when Southern Rhodesia Base Metals Corporation Ltd., the principal producer, ceased production at its Alaska mine, near Sinoia, the metal attracted little attention until 1950, when Rhodesia Copper Ventures Ltd. was formed to explore the Molly deposit further. On the results of the new exploration the Messina (Transvaal) Development Co. Ltd. acquired a controlling interest in Rhodesian Copper Ventures, and on October 1, 1954, a company known as M.T.D. (Mangula) Ltd. was floated with the object of bringing the mine into production. In 1959 the sulphide ore reserve was given as 25,335,000 tons, having an assay value of 1.36 per cent copper, equivalent to a contained copper content of 344,556 tons. In addition, the potential of a large body of oxide ore is being investigated. Production commenced during the latter part of 1957. In 1959 the main shaft had reached a depth of 1,166 ft. and the mine had been developed to the seventh level.

M.T.D. (Mangula) Ltd. is also preparing the Alaska mine to recommence production at an output of 500 t.p.d. In order to treat concentrates from the Alaska and Mangula mines, together with any other suitable copper ores or concentrates that might be available, a copper smelter has been built at Alaska Siding by the Messina Rhodesia Smelting and Refinery Co. Ltd. This will produce fire-refined copper. Another branch of the Messina group activities is the operation of the Umkondo copper mine in the Sabi Valley. The total ore reserve is given as being 360,160 tons containing 1.19 per cent copper in sulphide form and 2.16 per cent copper in oxide form. This mixed ore is successfully treated by flotation methods and the concentrate produced is sent 300 miles by road to Messina in the Northern Transvaal for smelting.

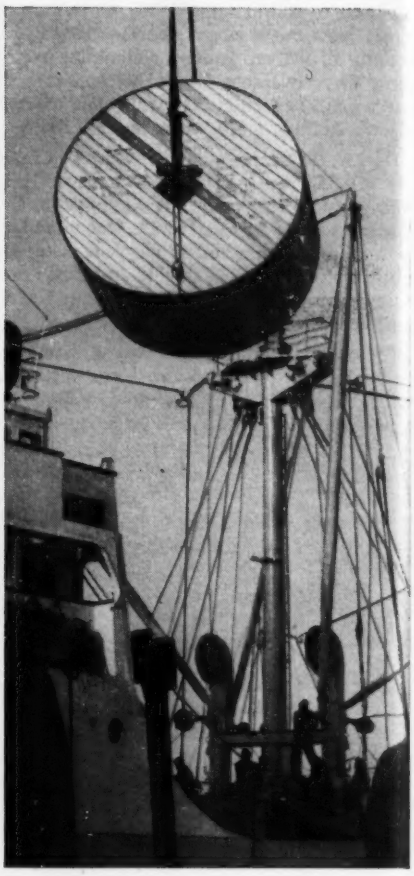
A bright future seems to be assured for the copper industry of the Colony, which, with further expansion, should become of major importance.

Lithium and Beryllium

Beryl is of widespread occurrence in Southern Rhodesia, which is now a major source of world supplies. Crystalline and massive beryl occur at Bikita, some 45 miles east of Fort Victoria, where a large body of greisenized pegmatite, nearly a mile long, contains considerable quantities of beryl, forming one of the world's largest deposits, as well as a very large concentration of lithium minerals.

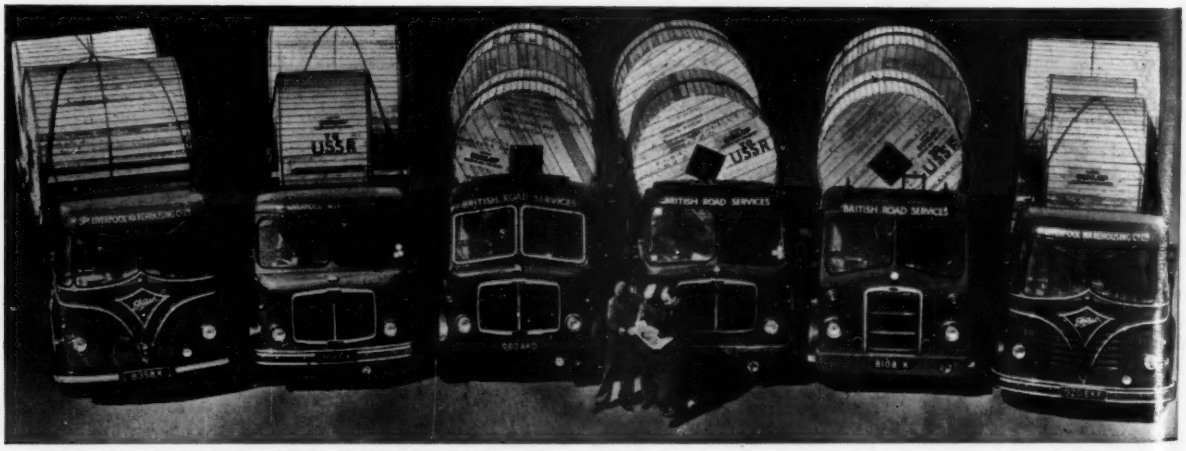
By far the largest and most important lithium deposit is that at Bikita which is owned and worked by Bikita Minerals (Pvt.) Ltd., a member of the Selection Trust Group. Early in 1960 Bikita Minerals (Pvt.) Ltd. acquired the adjoining

Russia orders miles of 'TERYLENE' CONVEYOR BELTING again and again



1959: 1st order—nearly 6 miles of 'Terylene' belting made by B.T.R. Industries Ltd. is shipped to Russia (see photograph on right).

1961: 2nd order—6½ miles of 'Terylene' belting made by the Dunlop Rubber Co. Ltd. ready to be loaded for export to Russia (photograph below).



Russia has recently placed her third order, this time with B.T.R., for 'Terylene' conveyor belting—five more miles of it. As usual, she specified 100% 'Terylene' duck.

Much of the belting is 79½ inches wide and 1½ inches thick—some of the widest and thickest ever made. It can transmit in excess of 2,000 H.P. with a maximum working tension approaching 60 tons. Despite enormous strength and thickness, the belting is very supple and troughs readily under its own weight.

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Al Hayat claims from G. H. Nolan (Pvt.) Ltd., and the whole deposit was brought under one control.

A detailed description of the Bikita deposit and the methods of mining employed there was published in *The Mining Journal*, June 3 and June 10, 1960.

Other Minerals

Tin is known to occur at a number of widely scattered localities throughout the territory. By far the most important field is that at Kamativi in the Wankie district, where an extensive swarm of tin-bearing pegmatites occur in a belt of garnetiferous mica schists some 25 miles long and one to two miles wide. In 1952 M. V. Billiton Maatschappij acquired the controlling interest in Kamativi Tin Mines Ltd. and a serious attempt at large-scale exploitation was immediately commenced. A small tin smelter came into operation at the mine in 1955. Production for 1959 was 641 tons of tin metal and 53 tons of concentrates. Two smaller companies are also operating on the Kamativi tin fields.

There are extensive mica fields in Southern Rhodesia and mica mining has been an important industry in the Colony for many years. The deposits are mainly confined to the Urungwe and Darwin districts in the northern part of the Colony, but a new field was recently discovered near Wankie.

Nickel mining commenced with the discovery in 1928 of nickel mineralization at the Noel mine, which at present is the only producer, but in no way reflects the Colony's full nickel potential. In 1955 the outlook for the establishment of a large nickel industry changed with the discovery of the Empress mine in the Ngondomo area west of Gatooma. The property was subsequently acquired by Mineral Search of Africa (Pvt.) Ltd., a subsidiary of Rio Tinto, and was explored and developed. Work has been temporarily suspended due to market conditions.

In 1958 the Bindura Nickel Co. (Pvt.) Ltd., an Anglo-Transvaal subsidiary, took an option over the Trojan claims situated to the south of Bindura. Exploration was successful in locating bodies of sulphide ores on which development and further exploration is in progress.

The production of tantalite and columbite concentrates constitutes a small but important industry. These concentrates are of various grades ranging from high tantalite, through mixed tantalite/columbite to high columbite. In addition, there is a significant production of microlite (calcium tantalate). The value of the production for 1959 was £66,862. The concentrates are won either as a by-product of pegmatite mining for other minerals or from small-scale mining operations in pegmatites or eluvial deposits.

Trial shipments of pollucite have recently been made from the Bikita Mine.

Antimony minerals have been produced on a small scale for many years, chiefly as a by-product of gold mining.

In August, 1959, Dorowa Minerals Ltd., a subsidiary of African Explosives and Chemical Industries (Rhodesia) Ltd., began the production of phosphates from its Dorowa Mine in the upper Sabi valley. Ore reserves have been calculated at 3,000,000 tons with a P_2O_5 content of 8 per cent, but it is considered that further exploration will considerably increase this estimate. Two orebodies have been proved. The production of apatite concentrates is now in operation, puddling, gravity concentration and magnetic separation being employed. There are many technical problems, however, to be overcome before the full-scale manufacture of phosphates comparable to imported products can be undertaken.

Other minerals which are being, or have been, mined in the Colony include barytes, clays, corundum, dolomite, fluorspar, graphite, iron, iron pyrites, lead and zinc, limestone, manganese, molybdenum, phosphate, quartz, silver, tungsten, vermiculite, and the platinum group metals.

Gemstones

In October, 1956, two prospectors working lithium-bearing pegmatites in the Belingwe area discovered emeralds. Preliminary cutting tests in New York resulted in small stones being produced which were described as being superb and entirely unique. The discovery led to a revival of interest in gemstones. Early in 1960, Rhodesian Chrome Mines Ltd. announced the first recorded occurrence of jade from Southern Rhodesia. Now that gemstones have attracted attention, states the book, it will be interesting to see what further discoveries are made.

Government Assistance

A Mining Affairs Board has been set up which consists of five government officials and up to six other members appointed by the Minister of Mines. Its primary duty is to give assistance to the industry, which may be in the form of direct financial aid, promotion of prospecting or exploration.

Financial assistance may take the form of direct loans to individuals or companies, a remission from the payment of royalty, or 50 per cent participation in a speculative exploratory development venture. The latter form of assistance is principally designed to assist mines where ore reserves are exhausted.

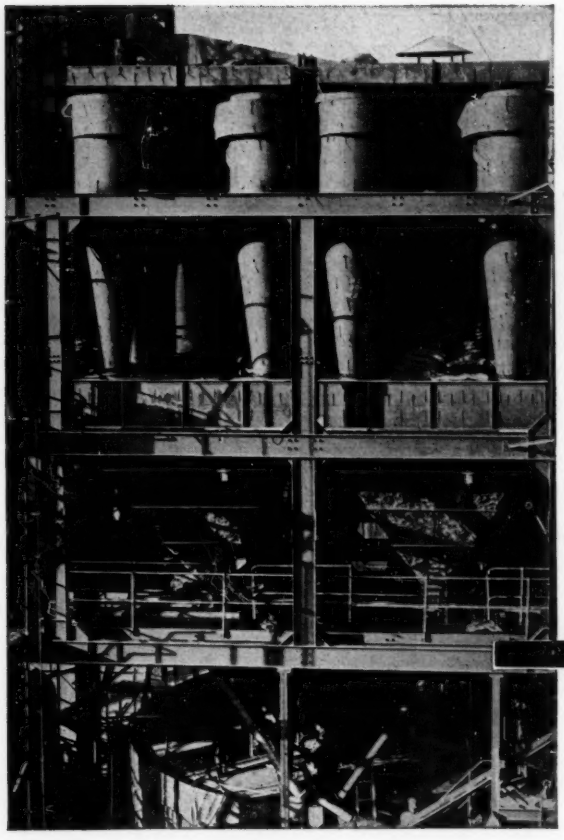
Prospecting and exploration may be promoted by the granting of exclusive prospecting rights, subject to certain conditions, over large areas of land up to 1,000 sq. miles in area for periods of up to five years. Since the inception of the scheme in 1947 a total of 96 exclusive reservations has been granted and over £6,000,000 has been spent by concession holders. This scheme has encouraged the prospecting of vast areas by large companies using the latest scientific techniques. Exclusive rights so far issued have covered an area of approximately 6,300 sq. miles representing 7 per cent of the total area of the country, excluding granite country.

The government has recently introduced an exploration section in the Department of Mines. The initial programme is entirely directed towards gold exploration, using a power augering unit designed to drill to a maximum depth of 5½ ft. Geochemical prospecting methods are also being employed. Any indication of a possible ore deposit will be followed by diamond drilling or other exploratory work. If an ore deposit of some potential is discovered, the Mining Affairs Board will invite tenders for an exclusive prospecting order.

The Mining Engineering Section has the two-fold function of providing mining engineering and metallurgical services free of cost to mines which require them, and of obtaining compliance with mining and related regulations. A metallurgical and chemical laboratory is attached to this section in Salisbury. Its purpose is to test, analyze and perform treatment tests on samples of ore and advise on the best methods to be employed in the recovery of minerals.

A plant and machinery hire scheme was launched in 1949 and has proved most popular. Its value to the mining industry lies in the fact that exploration syndicates can conserve their cash resources to finance working costs instead of dissipating their funds in the purchase of capital equipment.

The Geological Survey Department has its headquarters in Salisbury, with branch offices at Bulawayo and Gwelo. Regional mapping is all undertaken from Salisbury, while the branch offices deal entirely with economic geology. A Minerals Information Bureau was introduced towards the end of 1958. Its initial function was to compile all available records on mineral production, the producers, locality of deposits, markets, and end-products of base mineral ores. The programme envisages that ultimately every possible type of information concerning mineral production in Southern Rhodesia, will be available to local and overseas industrialists.



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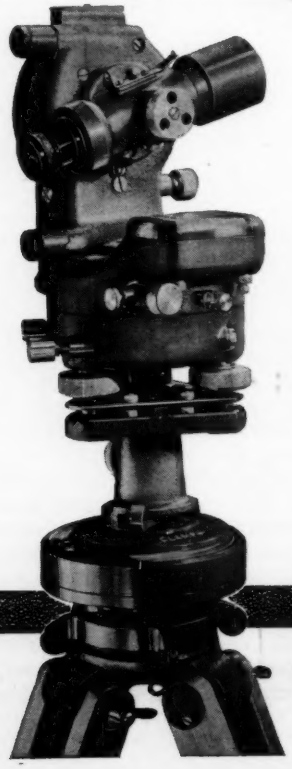

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lachinery and Equipment

New Dryers Process 420 t.p.h. of Coal (Fluid-Flo)

The first installation of a new type of yer has been recently put into service the Enos Coal Mining Co., Oakland ity, Indiana, U.S. Two dryers were inalled to upgrade the product by deeasing its moisture and to make a better oduct for customers to unload in cold eather. It had previously been necesry to "freeze-proof" the coal in winter ith calcium chloride or sodium chloride rine. The dryers are know as Fluid-Flo nd are made by the Link-Belt Co. of hicago.

The two dryers process three grades of oal simultaneously. The No. 1 dryer is esigned to handle 165 t.p.h. of $\frac{1}{16}$ in. by 10-mesh washed coal, reducing the moisture content from 20 per cent to 11 per cent. However, the coal is now being dried to 10 per cent total moisture.

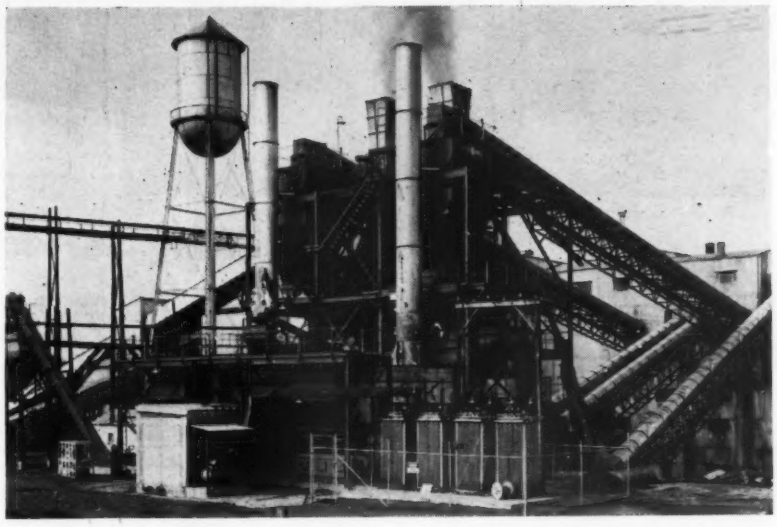
The No. 2 dryer is designed to handle simultaneously 165 t.p.h. of 1 in. by $\frac{1}{16}$ in. washed domestic stoker coal and 100 t.p.h. of 10-mesh by 28-mesh washed coal, reducing the moisture content from 15 per cent to 11 per cent. However, this coal, too, is now being dried to 10 per cent total moisture. The two sizes of coal are separated by vibrating screen after drying, before being returned to the loading-out points at the preparation plant.

The drying plant is located about 125 ft. from the preparation plant and is connected with the plant by means of a belt conveyor system. One 24 in. wide belt conveyor, 150 ft. horizontal centres, carries the wet $\frac{1}{16}$ in. by 10-mesh coal to the surge bin serving the No. 1 dryer. A 30 in. wide belt conveyor receives the two sizes of coal (1 in. by $\frac{1}{16}$ in. and 10-mesh by 28-mesh) from two belt conveyors in the preparation plant and carries them together to the surge bin serving the No. 2 dryer.

Coal is dried in the dryer without coming in contact with any moving parts. The coal is delivered to the dryer by screw feeders at the base of the surge bin. Hot gases are pulled up through a constriction plate within the dryer by an exhaust fan, thus suspending or fluidizing the bed of material in the dryer. As the individual particles in the bed of material become completely surrounded by the hot air, the drying function is performed. At the same time the coal flows like water and travels horizontally directly over the constriction plate towards the discharge end of the dryer, where it is removed from the dryer through a motorized rotary gate which also serves as an airlock.

The fines remain suspended in the hot gases and are gathered in a dust collector. They are recombined with the coarser material delivered by the dryer, thus drying the coal with a minimum of dust loss.

The dried coal from the No. 1 dryer is returned directly by 24 in. wide belt conveyor to a storage bin in the preparation plant. Dried coal from the No. 2 dryer is discharged to a Link-Belt CA single-deck 6 by 14 ft. vibrating screen. The 1 in. by $\frac{1}{16}$ in. dried coal passes over the deck and is returned to the preparation plant by a 24 in. wide belt conveyor. The 10-mesh by 28-mesh coal passes through the screen to a 24 in. wide flight conveyor which delivers it to a belt conveyor leading to the preparation plant. Fines from the dust collectors for both dryers also are discharged through chutes on to this belt.



A drying plant containing two of the new Link-Belt Fluid-Flo dryers recently installed at the Enos Coal Mining Co. preparation plant near Oakland City, Indiana, U.S.

Coal for the furnaces is obtained by screw feeder from the surge bin serving the No. 2 dryer and is carried by a system of screw conveyors to the stoker fuel surge bin. Coal from the No. 2 dust collector can also be routed to the stoker fuel system. Ashes are conveyed by flight conveyor to a storage bin for truck loading.

As indicated by the fact that both Fluid-Flo dryers are removing 1 per cent more moisture than originally specified, Enos Coal Mining Co. has found them highly satisfactory.

SKIPS IN OPEN-PIT MINING

Asbestos ore from the Canadian Johns-Manville Jeffrey open-pit is soon to be hauled by two 35-ton skips operating on a 45 deg. incline and feeding a battery of four jaw crushers. The reason for the switch from truck-hauling to the existing crusher is to cut out the long haul from the pit bottom up the twisting haul-road, over one mile in length, and on a nine per cent grade.

Trucks will still be used in conjunction with the C.J.-M. skiphoists to haul the ore from where it is mined to the skip loading site at the 360 ft. level on the south side of the pit. By next spring, a similar but smaller system will be in operation at the Flintkote open pit in Thetford Mines.

In the Jeffrey Mine the skiphoist headframe will be located the motors for operating the skips, an 850 ton ore storage bin and four 48 by 60 in. jaw crushers. The head-frame building will be steam-heated. From the crushers, the ore will be transported to the dry rock storage shed by a system of conveyor belts. Made in Canada, one single 48 in. belt will be 1,012 ft. long. A 500 h.p. motor and a complex hydraulic coupling are needed to power it.

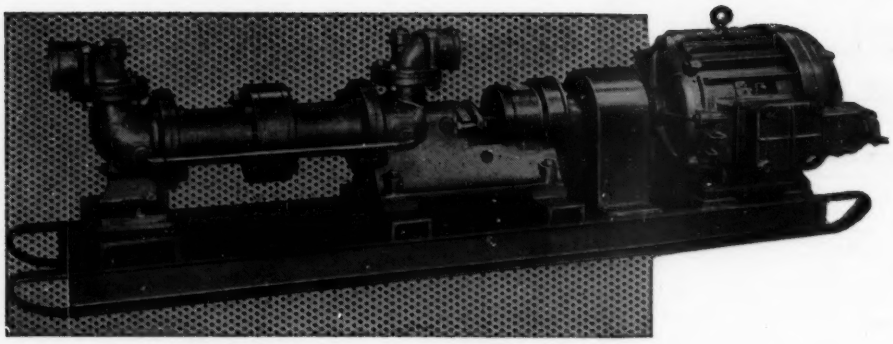
Another innovation will be the special 2 in. lock-coil cable with a flat, non-circular section. Made of special steel, the cable will haul the skips which will operate in tandem. Although $2\frac{3}{4}$ in. dia. cables would normally be required for such a hauling job, the flat 2 in. cable has the same strength as its larger counterpart. C.J.-M. already has 14 ft. hoist-drums with 2 in. grooves.

Operation of the hoists will be completely automatic. However, an operator will be needed to work the crushers and control the trucks dumping into a drive-over structure at the skip-loading point. Work on the project started last spring. C.J.-M. plans call for the eventual installation of a similar system on the north-west side of the open-pit, near the observation tower, for removing waste rock. The new project has been described in *Asbestos*.

CLEANING MINE WATER

New techniques for the settling and clarification of underground water in mines were recently described to the South African Institute of Mining and Metallurgy by Mr. J. W. de Villiers.

These revolutionary techniques include the introduction of the inflow in the cleaning system from the bottom, instead of the top, of the sump leading to the pumps and allowing it to flow the short width distance and not the length. This results in a considerable slowing down of the water allowing it to drop its dirt load. The problem of finer matter in stable suspension is solved in what is described as "dynamic filtration", which allows the cloudy water to rise through a bed of flocculated particles in a V-shaped trough. The finer suspended particles in the inflow rise and strike the descending microscopic particles in the comparatively still water in the trough. Coagulation then occurs bringing the two particles down. The effluent is virtually clear water.



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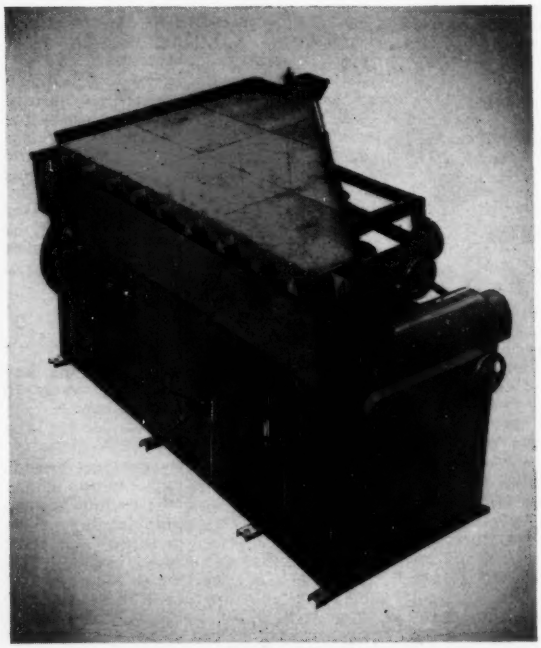

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MINING MISCELLANY

Figures released in Bucharest show that about 1,460,000 tonnes of iron ore and 8,163,000 tonnes of coal were produced in Roumania during 1960, representing increases of 37 and 2 per cent respectively over the 1959 output.

★

The High Authority of the European Coal and Steel Community has informed the government of Niger that it is not able to grant money for the exploration of iron ore and manganese ore deposits in the Niamey area on the right bank of the River Niger. The Niger authorities were hoping for a grant of 36,000,000 C.F.A. francs. The Authority stated that at present such investment was not sufficiently promising, the distance of the reserves from the coast indicating that transportation costs might not be economic. The Niger government may now seek aid from certain West European governments to cover the exploitation of the deposits.

★

Large resources of pyrites, exceeding 80,000,000 tons, have become available in the Amjor region, reports our Indian Correspondent, and the Pyrites and Chemicals Development Corporation is carrying out investigations in association with the Norwegian firm of Orkla, for setting up a smelter with a daily capacity of 400 tons. It is hoped to develop a project by which acid made from pyrites will meet at least 50 per cent of India's requirements by the end of the Third Plan. The Pyrites and Chemicals Development Corporation is considering setting up sulphuric acid units, of 400-500 tons daily capacity, near the fertilizer factories in Durgapur and elsewhere.

★

Howe Sound Co. of U.S., has sold its El Potosi mine in Mexico to a Mexican buyer, M. Mariano Valenzuela Ceballos, for $800,000. This transaction, was undertaken in view of the recent amendments to the Mexican mining law, which make it desirable for U.S. companies to sell at least 51 per cent interest in their Mexican operations to Mexican nationals. According to a statement by Howe Sound the ore reserves have been depleted and profits were small.

★

The question of power for the coming expansion of the Bell Bay aluminium works in Tasmania is raising questions. The decision, which was influenced by economic considerations, is for hydro-electric power to be generated by the Tasmanian Hydro-electric Authority at a new station to be erected on the Derwent River. There is, however, an important coalfield in the Fingal Valley, in the central east coast, a producer of high quality coal in which a substantial amount of capital has been invested. This high quality producer is now affected by the inroads of the Island's hydro-electric undertakings, resulting in loss of trade and the displacement of labour. Consideration is now being given to a thermal station in the Fingal Valley, instead of the planned hydro plant on the Derwent River.

A report from München Gladbach, West Germany, states that the reserves of brown coal estimated at 4,000,000,000 in the Rhenish fields at present under open cast exploitation will last for the coming forty years. The Rhenish seams contain a total of 60,000,000,000 tonnes. Deposits aggregating a further 4,000,000,000 tonnes, in addition to the amount already being mined, are stated to merit exploitation, and their working is foreseen in long-term plans.

★

As a result of recent studies of molybdenum ore deposits in Toerdal, Southern Norway, the firm of Heede A/S, are planning to spend some 2,500,000 Kr. on making further large-scale tests this autumn. If these tests prove satisfactory, as is anticipated, mining will be started, and a concentrator with an annual capacity of 20,000 tonnes, will be built to handle the ore. The concentrate would be shipped through the port of Krageroe in South Norway.

★

The National Metallurgical Laboratory at Jamshedpur, India, is investigating manufacture of cryolite from low-grade fluorspar containing a high percentage of silica. Fluorspar of this type is available in Rajasthan, Madhya Pradesh and Bombay. At present cryolite is imported into India from Denmark and Greenland, about 7,500 tons being imported annually.

★

Production figures for the state of Hesse, Western Germany, during the first half of 1961 include 830,000 tonnes of iron ore, 4,640,000 tonnes of crude potassimum salts and 360,000 tonnes of potassium fertilizer salts. These figures represent increases over the corresponding period of 1960, of 8.4, 3.8 and 0.8 per cent respectively. Hesse now produces about one-half of all potash mined in Western Germany and 9 per cent of the national iron ore production.

★

A shipment of some 1,600 tons of barytes from old mines at Derryginnock, near Bantry, in County Cork, Eire, is being sent to Liverpool. The barytes was mined years ago and is still lying in stockpiles near the surface, but two local engineers connected with the existing copper mines at Allihies are proposing to start work on de-watering the old shafts, preliminary to opening the mine.

★

The China National Metals and Minerals Import and Export Corporation has replaced the former Chinese foreign trading organization, the Metals and Minerals Corporation. For trading in machinery, including mining equipment, the China National Machinery Import and Export Corporation has been formed, in which are merged the three former bodies trading in machines, instruments and transportation and mechanical handling machinery. The address of both new organizations is at Erh Li Kou Hsi Chiao, Peking. Representatives will shortly be visiting Britain.

As part of Pakistan's plans for the expansion of mineral resources, the U.S. is increasing its assistance in the field of geological research, and teams of Pakistani and American geologists are working to evaluate mineral deposits. Survey activities are to be stepped up in the Hazara District, which contains the largest known number of mineral deposits in Pakistan. The U.S. is planning an expenditure of $1,358,400 for the fiscal years 1961/2 to meet Pakistan's expanded programme, which includes the development of coal resources in the Sore Range-Daghari area, mineral resources of the trans-Indus range, coal resources in the Khost-Sharigh area and chromite resources in the Hindu Bagh area.

★

A new dolomite mine has been opened at Ujmassa, Northern Hungary.

★

The U.S. office of Business Economics, anticipates that during 1961 some $1,030,000,000 will be spent on capital expenditure for plant and equipment by the U.S. mining industry, representing a 4 per cent increase on the expenditure recorded for 1960.

★

Non-ferrous metal ore reserves have been found in the Hruby Jesenik hills of Czechoslovakia and, according to Czech reports, are amongst the largest in Europe. Reserves in seams of 2 metres to 40 metres thick, are stated to contain several million tonnes of ore. Work is already under way in the Hruby Jesenik area on the construction of metal mines and processing units, particularly in Horni Benesov and Zlate Hory.

★

North Korea plans to raise its iron ore mining capacity to permit annual production of 3,500,000 tonnes of pig iron and 2,500,000 tonnes of raw steel. In 1959, with an iron ore output of 2,703,000 tonnes, North Korea produced 694,000 tonnes of pig iron and 451,000 tonnes of steel. Coal output is to be raised to an annual figure of 23,000,000 tonnes, compared with under 9,000,000 in 1959.

★

Japan's steel production in the first half of 1961 totalled 14,600,000 tons, being 26 per cent more than in the first half of 1960.

★

International Minerals and Chemical Corporation plans a $10,000,000 expansion of its Canadian potash production plant at Esterhazy, Saskatchewan, where capacity, at present 420,000 tons annually, is to be raised to 1,200,000 tons annually by 1963. The expenditure would raise total plant investment to about $40,000,000. The company expects North American agricultural potash demand to rise by 6.5 per cent annually during the next few years.

★

As a result of the re-organization within the mining sector of the Ministry of Basic Industries and Mining in Indonesia, BUPTAN has been officially dissolved, and four bodies created in its place : one to manage state coal mining enterprises; one to manage state tin mining enterprises, one for oil and earth gas, and one for the extractive industries other than coal, tin, oil and gas. All these sections are subdivided to cover their respective areas.

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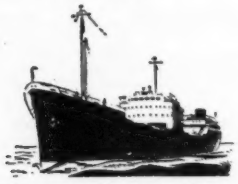

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Metals and Minerals

Beryllium in Nuclear Reactors

Precision fabricated beryllium worth about $1,000,000 has been used in the 43 in. dia. matrix of a new nuclear reactor which went into operation recently at Mol, near Brussels. The reactor has been designed for research and testing materials and is characterized by its high degree of versatility and flexibility. It is the first reactor in the world to have a complete matrix made of beryllium. The hexagonal beryllium rods used in its construction were made by Brush Beryllium Co.

Beryllium was selected because of its desirable neutron, thermal and structural qualities. The matrix holds the enriched uranium in aluminium tubes, control rods and water coolant elements. It also performs a slight moderating function and acts as a spacer between the uranium and control elements. It was also used for the hollow plugs in the test material tube spaces and there is a lower base section of the metal which serves as a neutron reflector.

The Belgian reactor project, financed by a government corporation in co-operation with industrial undertakings, will be made available to other West European interests for testing materials and elements, and it is expected that the Americans will also make use of its facilities.

A close watch is being kept on the use of beryllium in nuclear reactors, for a big expansion of markets for the metal could come during the next decade if its performance is proved satisfactory. The British Windscale gas cooled reactor will use a certain amount of beryllium and it is understood that the Japanese are considering the construction of a reactor in which considerable quantities of the metal might be used.

★

The Brush Beryllium Co. of Cleveland, Ohio, has invested $3,000,000 in a new plant which will replace three smaller fabricating units and will increase the company's production by one-half. Mr. George S. Mikhalapov, president of Brush Beryllium, said the new plant would raise the company's efficiency in turning out finished beryllium metal parts. Recalling that the price of fabricated beryllium three years ago was around $250 a lb., he said that continued progress along the lines of present development would eventually bring about a substantial reduction from the present price of about $150 a lb.

★

The U.S. Beryllium Corporation, America's largest producer of beryllium ores, has stepped up ore production to meet growing industrial demand. From its Boomer and Redskin Mines the company is now supplying a ton per day of 8 per cent (and higher) beryllium oxide (BeO) content ores to Mineral Concentrates and Chemical Company (Mincon), of Denver, as a preliminary to a full expansion programme that will be underway in September. The ore is being shipped to Mincon's mill at Loveland, Colorado, where it is being converted by direct process into high purity oxides.

In addition to the shipments of high grade beryllium ores, U.S. Beryllium is continuing its programme of stockpiling middle and low grade beryllium ores. These are for Mincon's new concentrating plant currently under construction near U.S. Beryllium's Boomer Mine. It is understood that so far, more than 1,000 tons of middle and low grade ores have been stockpiled.

Mincon's concentrating plant, scheduled for completion in September will employ a new, inexpensive water flotation process which can upgrade U.S. Beryllium's ores to as high as 33 per cent BeO content, the highest percentage known. It is the world's first commercial source of beryllium ore concentrate.

★

Standard Beryllium Corporation has announced its intention of building a concentrator at its Boa Vista beryl orebody in Brazil. This plant, which will have an annual capacity of 100,000 tons, is expected to be in operation early in 1962, after which the company proposes to build a second and similar concentrator at Boa Vista.

★

What are described as substantial deposits of low grade beryl ore have been found in properties of Chemalloy Minerals Ltd. near Bernie Lake, Manitoba. It is emphasized that they are not complex beryllium bearing clays, which are more difficult to concentrate than beryl ore. Minimum indicated reserves of the ore are put at 600,000 tons containing about 1,800,000 lb. of beryllium oxide.

It is understood that Chemalloy is planning to erect a concentrator which is expected to use a Canadian engineered flotation process. Output will most probably be sold to Beryllium Corporation, Brush Beryllium and possibly other fabricators in the U.S. There are also suggestions that ore may by supplied to Metallgesellschaft in Germany.

★

An international conference on The Metallurgy of Beryllium is to be held in the Assembly Hall of the Royal Commonwealth Society, Craven St., London, W.C.2, from October 16-18, 1961. There is a large mass of hitherto unpublished work on beryllium, and the purpose of the conference is to publish and discuss this work, which covers the whole field of the metallurgy of beryllium, with the exception of the extraction processes.

LONDON METAL AND ORE PRICES, AUGUST 24, 1961

METAL PRICES

Aluminium, 99.5%, £186 per ton
Antimony—
English (99%) delivered, 10 cwt. and over £230 per ton
Arsenic, £400 per ton
Bismuth (min. 1 ton lots) 16s. lb. nom.
Cadmium 11s. 0d. lb.
Cerium (99%) net, £15 0s. lb. delivered U.K.
Chromium, Cr. 99% 6s. 11d./7s. 4d. lb.
Cobalt, 12s. lb.
Germanium, 99.99%, Ge. kilo lots 2s. 5d. per gram
Gold, 250s. 11d.
Iridium, £20/£23 oz. nom.
Lanthanum (98%/99%) 15s. per gram
Magnesium, 2s. 2¼d./2s. 3d. lb.
Manganese Metal (96%/98%) £275/£285
Nickel, 99.5% (home trade) £660 per ton
Osmium, £17/£22 oz. nom.
Osmiridium, nom.
Palladium, Imported, £8 12s. 6d.
Platinum U.K. and Empire Refined £30 5s.
Imported £27 7s. 6d./£27 17s. 6d.
Quicksilver, £63 ex-warehouse
Rhodium, £43/£45 oz.
Ruthenium, £14/£16 oz. nom.
Selenium, 46s. 6d. per lb.
Silver, 79¾d. f. oz. spot and 80¾d. f'd.
Tellurium, 37s. 6d. lb.

ORES AND OXIDES

Antimony Ore (60%) basis	30s. 0d./33s. 0d. per unit c.i.f.
Beryl (min. 10 per cent BeO)	270s./275s. per l. ton unit BeO
Bismuth	30% 5s. 0d. lb. c.i.f. 20% 3s. 3d. lb. c.i.f.
Chrome Ore—	
Rhodesian Metallurgical (semifriable 48%) (Ratio 3 : 1)	£15 5s. 0d. per ton c.i.f.
„ Hard Lumpy 45% (Ratio 3 : 1)	£15 10s. 0d. per ton c.i.f.
„ Refractory 40%	£11 0s. 0d. per ton c.i.f.
„ Smalls 44% (Ratio 3 : 1)	£13 5s. 0d. per ton c.i.f.
Baluchistan 48% (Ratio 3 : 1)	£11 15s. 0d. per ton f.o.b.
Columbite, Nigerian quality, basis 70% combined pentoxides (Ratio 10:1) $Nb_2O_5 : Ta_2O_5$	150s./160s. 0d. per l. ton c.i.f.
Lithium Ore—	
Petalite min. 3½% Li_2O	50s. 0d./55s. 0d. per unit f.o.b. Beira
Lepidolite min. 3½% Li_2O	76s. 0d./80s. 0d. per unit f.o.b. Beira
Amblygonite basis 7% Li_2O	75s. 0d./85s. 0d. per ton f.o.b. Beira
Magnesite, ground calcined	£28 0s./£30 0s. d/d
Magnesite Raw (ground)	£21 0s./£23 0s. d/d
Manganese Ore Indian—	
Europe (46%-48%) basis 60s. 0d freight	73d./75d. c.i.f. nom.
Manganese Ore (43%-45%)	69d./71d. c.i.f. nom.
Manganese Ore (38%-40%)	nom.
Molybdenite (85%) basis	10s. 0d. per lb. (f.o.b.)
Titanium Ore—	
Rutile Australian 95/97% TiO_2 (prompt delivery)	£24 5s. per ton c.i.f.
Ilmenite Malayan 50/52% TiO_2	£11 10s. per ton c.i.f.
Ilmenite Travancore 58/60% TiO_2	£15/£15 10s. per ton c.i.f.
Wolfram and Scheelite (65%)	127s. 0d./130s. 0d. per unit c.i.f.
Vanadium—	
Fused oxide 95% V_2O_5	7s. 6d./8s. per lb. V_2O_5 c.i.f.
Zircon Sand (Australian) 65-66% ZrO_2	£16 ton c.i.f.

THE MICA INDUSTRY IN INDIA

Indian mica mine-owners are curtailing the working of many of their mines owing to what they term "irregular and inadequate" supply of explosives. Representatives of the mica industry, who met the Bihar Deputy Minister of Industries, Mr. Kamaldeo Narayan Sinha, at Hazaribagh recently, informed him that 73 per cent of their normal supply of explosives had been cut down. This had resulted in the partial closure of many productive mica mines in Hazaribagh District, which accounts for 80 per cent of Indian mica.

They suggested to Mr. Sinha that the Government of Bihar should urge the Union Government to ensure restoration of normal supply of explosives for the mica mining industry. Meanwhile they suggested that the quotas for mica mines should be fixed on a pro rata basis.

India's mica exports declined to 2,120 tonnes in June, 1961 from 2,270 tonnes in the previous month, but the earnings from such exports increased to Rs. 9,180,000 from Rs. 8,940,000. Ex-

ports of block mica, which commands a high price in world markets, rose from 230 tonnes in May to 270 tonnes in June.

Indian mica has gained some ground in the Italian market despite increased competition. Supplies of raw mica to Italy from India rose to 420 tonnes in 1960 from 71 tonnes in 1956. India is the most important supplier of both raw mica in blocks and trimmed splittings.

ELECTROLYTIC MANGANESE

Péchiney and Aciéries de Paris et d'Outreau are to form jointly a new company on a fifty-fifty basis to produce and sell electrolytic manganese. The new company, to be known as les Métaux Purs Péchiney-Outreau M.P.O., will have an initial capital of 5,000,000 new francs. A plant with an initial capacity of 3,000 tonnes per annum is to be built in Boulogne sur Mer in Northern France. An agreement on the exchange of technical knowledge has been signed with the U.S. company, American Potash, which is to undertake a similar project in the U.S.

It is interesting to recall that only a few days ago we reported that another U.S. concern, the Foote Mineral Co., had decided to develop markets for electrolytic manganese in Europe (*The Mining Journal*, Aug. 11, 1961, p. 147).

AUSTRALIAN RUTILE

A better tone has lately been discernible in the Australian rutile shipment market. The very cheap offers which a few weeks ago were depressing the market have now disappeared and throughout this month prices have been tending to harden. At the time of writing the price ideas of most dealers in London seem to range from £24 5s. to £25 10s. per l.ton c.i.f. Europe, which compares with £23 10s. to £25 10s. previously. There was a time last month when a cheap seller was offering rutile on the European market at under £20. Now most sellers are indicating £25-£25 10s. and, in an isolated case, slightly more. Offers are applicable for shipment this year.

Sellers generally are reluctant to quote lower prices because of increased reserve on the part of producers in Australia, where efforts are still being made to rationalize the industry. The opinion has been expressed that supplies of cheap rutile are well on the way out, and that stocks in the hands of the traditional Australian producers are probably much less embarrassing than they were.

A certain amount of buying interest continues. This should broaden once the holidays are finished and consumers start seriously thinking about covering some of their anticipated future requirements.

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LOWER WOLFRAM PRICES

Wolfram ore shipment prices in London lost ground this week and are now indicated at 127s.-130s. per l.ton unit c.i.f. Europe compared with 128s.-132s. as quoted in our last week's issue. Apart from some business reported by Japan at the bottom end of the range, buying interest remains dull. In the absence of any useful revival of business during the next few days, the possibility of a further easing in prices cannot be ruled out.

BRIGHT PROSPECTS FOR CAESIUM

Steady growth is predicted for caesium, which is the subject of a recent survey by J. P. Ruth in *American Metal Market*.

This unusual metal vapourizes at a moderately low temperature to produce an electrically conducting gas. This property and others make caesium a very desirable metal for plasma gases in several new types of engines and thermionic or heat-to-electric generators. Research on caesium is being expanded and U.S. firms have received contracts from the government to develop new devices which are likely to use this metal.

Some work is being done on the alloying effects of caesium, but the big potential market seems to be the fields of new electronic technology such as thermionics. There may also be some nuclear and thermocouple applications. Compounds of the metal are used in glass and ceramics. A caesium powered ionic rocket is reported to have been designed and a 112-day caesium flight to Venus is in the blue-print stage.

High purity caesium sells for about $375 a lb. in quantities of 1-4 lb. and perhaps less than one ton was produced last year. Production of caesium of a purity exceeding 99.9 per cent was announced last month by Dow's Metal Department. U.S. firms concerned with caesium also include American Potash and Chemical, San Antonio Chemicals, Penn Rare Metals, and Kawecki Chemical Co. Among others engaged in research and experimental studies is Howe Sound Co.

Dow Chemical Co. draws its raw materials from Chemalloy Minerals Ltd., which owns large deposits of caesium minerals in Manitoba, which are believed to be the world's largest known source. Other extensive deposits of pollucite, the principal caesium ore, are those of Bikita Minerals in Southern Rhodesia, T.C. Mining Co. of Maine, and Montgary Exploration at Bernic Lake, Manitoba. Pollucite is also produced in small quantities in South West Africa as a by-product of lithium ores.

HIGH-PURITY SILICON

Because of rapid changes in prices and technology, the Bureau of Mines, U.S. Department of the Interior, began collecting silicon production data on a quarterly basis to aid in economic and technical planning. Furthermore, to follow trends in the industry, the weight units of silicon have been changed to kilograms and grade units to ohm-centimeters of resistivity.

In the second quarter of 1961, 9,800 kg. of polycrystal was produced in the U.S., which was a 29 per cent increase over the 7,600 kg. produced in the first quarter. In an average quarter in 1960, 8,000 kg. of polycrystal-silicon was produced. A total of 1,960 kg. of single-crystal was made in the second quarter which was a 13 per cent decrease from the 2,260 kg. produced in the first quarter.

Prices have remained unstable since the autumn of 1960 and no firm listing is known to exist. As in certain areas of the electronic device manufacturing industry, the high-purity silicon producing industry has an over-capacity which has contributed to the price structure of polycrystal deteriorating to a low and fluctuating level.

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Foreign experts (believed to be German) have recently made studies for the extraction of silicon at Lake Myvatn in Iceland. It has been announced that the lake contains some 50/60 years' supply of silicon based on an annual production of 100,000 tons. The foreign experts have stated that it would be possible to extract the silicon by means of pumps mounted on floating rafts. The silicon would be dried by geothermal steam. Conversations between foreign interests and the Iceland authorities are said to be in progress.

COBALT IN WEST GERMANY

The Duisburger Kupferhütte company, of Duisburg, Federal Germany, has announced plans to raise its cobalt production to 1,700-1,800 tonnes per year. For 1960, when Kupferhütte accounted for 9.5 per cent of the total Free World output of cobalt, its production amounted to 1,450 tonnes, exceeding the 1959 total by 10 per cent.

(Continued overleaf)

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U.S. SELENIUM OUTPUT

U.S. domestic production of selenium and selenium compounds in the second quarter of 1961 was 345,154 lb. of contained selenium, according to reports received by the Bureau of Mines, U.S. Department of the Interior. This output was 65 per cent more than the 1961 first quarter production. Shipments in the second quarter of 1961 totalled 307,611 lb. of contained selenium, compared with 169,243 lb. shipped in the first quarter.

ALUMINIUM IN U.S. CARS

Despite the present cautious approach, most U.S. built motor cars will have aluminium engines by 1966, and by 1970 the use of 300 lb. of this metal per car will not be unusual. This forecast was made by Mr. J. M. Smith, Alcoa's manager for automotive development, in addressing a meeting of Security Analysts in Portland, Oregon. According to Mr. Smith the average U.S. car now uses a total of about 63 lb. of aluminium. If the motor car industry used this light metal in all applications where it has been found suitable, more than 500 lb. could be taken off the weight of a 4,000 lb. car.

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A survey by a leading aluminium company indicates that the use of aluminium by the U.S. transportation industry may be expected to increase by 78 per cent from 480,000 tons in 1960 to 856,000 tons in 1965. The biggest increase is foreseen in the automotive industry, which is expected to use 500,000 tons in 1965, based on a 7,500,000 car year, which would compare with 225,000 tons used in 1960.

The use of aluminium for aircraft and missiles is expected to decline by 28.6 per cent over the same period, due to the aircraft industry's emphasis on missiles and its diversification into other products. On the other hand, it is predicted that the use of aluminium for rockets will rise to 17,500 tons in 1965 from "a few million pounds" in 1960.

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The first ton of alumina obtained from "ordinary" clay has been sent from an assay laboratory to an aluminium foundry in Skawine, Cracow, according to the Polish news agency *PAP*. The alumina was obtained by the method of Professor Bretsznajder, a Polish chemist, after many years of research. The report states that a specially appointed commission of the Polish Academy of Sciences has approved the new method and has proposed the construction of an alumina plant with a capacity of 200,000 t.p.a. The plant is expected to be finished in 1964.

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A report published in *Soviet News* states that assembly of the equipment of a new aluminium pilot plant has started at Pavlodar, a new industrial centre in Kazakhstan. It will be used to test a new process producing alumina and aluminium for the commercial-scale plant under construction at Pavlodar. The production of alumina will be based on the Bayer process, it is stated, but the tailings, usually treated as waste, will be additionally processed in rotating sintering kilns, which will increase the alumina yield. The plant is being built on the site of a bauxite deposit discovered at Turgai, in the south of the Tselinny Territory. The first section is expected to go into operation in 1962.

Copper · Tin · Lead · Zinc

(From Our London Metal Exchange Correspondent)

Interest in markets has remained at a low ebb, although with the gradual return to work after the holidays more enquiries are circulating.

COPPER STILL LITTLE CHANGED

In spite of the continuation of the strikes in Chile and the United States, the copper market has failed to develop any substantial upward momentum. The atmosphere in America seems slightly better but the atmosphere in Chile appears to have deteriorated. A number of experts believe that a rise in price during the next month is almost a certainty. In the United States news continues to be "bullish" although the possibility of a strike in the motor industry at the end of this month is a restraining influence. The custom smelters have increased their intake price for No. 2 scrap from 26.25 c. per lb. to 26.62 c. per lb.

The U.S. Copper Association figures for July show that the domestic consumption of coppper by brass and wire mills and foundries totalled 97,374 s.tons as compared with 122,467 s.tons in June. New business booked in terms of refined copper fell to 111,347 s.tons from 122,035 s.tons, but unfulfilled orders rose to 153,049 s.tons from 139,585 s.tons and fabricators stocks at the end of July were 472,488 s.tons as compared with 456,431 s.tons a month earlier.

London Metal Exchange stocks rose by 98 tons to 21,839 tons and the contango rate remained around 60s. per ton.

TIN PRICES SPURT

The tin market has once again been the feature of the week, with very substantial price rises in both Singapore and London. It would appear that with the resumption of industrial activity demand is likely to remain brisk for some weeks provided the price does not reach a level which frightens consumers. It is extremely difficult to estimate at what level this would happen, but there are indications that there is still a tonnage of tin which must be bought, and this may cause the price to reach the £1,000 per ton mark within the next few weeks.

At the end of last week it was announced that the meeting of the International Tin Council scheduled for August 22 had been postponed; no reason was given for this action. As was to be expected in the circumstances, there has been much speculation as to the reasons. The most popular is that producer countries have not yet had time to collect the required information as to production costs. It is understood that the meeting is now likely to take place towards the middle of September.

Stocks in official warehouses fell 92 tons to a total of 5,919 tons, and the contango rate narrowed slightly to about ten pounds per ton.

It was announced in Washington on Wednesday that another 1,000 l.tons of Longhorn grade tin will be offered for sale by the General Services Administration on September 12. G.S.A. offered 500 tons of this tin for sale in the beginning of August and sold 350 tons. It has scheduled a second sale of 1,000 tons for August 30. In spite of Washington's announcement, the Eastern price rose further on Thursday to £972½ per ton c.i.f. Europe.

ZINC'S WEAKER UNDERTONE

The lead market remains relatively unchanged with reports that some consumers are having difficulties in obtaining their favourite brands of the metal. Overall, however, there appears to be no shortage, and in spite of a further reduction in stocks in Metal Exchange warehouses of 291 tons bringing the total down to 9,958 tons, the contango rate has remained around 30s. per ton.

The zinc market, however, has developed a distinctly weaker undertone, brought about by a sharp increase in stocks of 752 tons, bringing the total to 7,011 tons, and free offerings of higher grade metal both in the U.K. and in Europe. When the possiblity of a strike in the U.S. automobile industry is added to these factors it is generally believed that the market will decline further.

BROKEN HILL SELLS SURPLUS LEAD

An announcement by The Broken Hill Associated Smelters Pty. Ltd. states that agreement has been reached for the sale of 45,000 s.tons of surplus stocks of lead metal to the Commodity Credit Corporation, an agency of the U.S. government. Delivery is to be over a period not exceeding twelve months. The sale is part of the programme announced by the representatives of the U.S. government at the International Lead and Zinc Study Group meeting in Mexico City in April to barter surplus agricultural commodities for surplus lead under certain conditions. One condition is that Broken Hill Associated Smelters and Broken Hill mining companies during the calendar year 1961 undertake not to sell or produce in excess of figures provisionally agreed upon at the Mexico City meeting. This means in effect that the 10 per cent cutback which Broken Hill had accepted for the first half of 1961 is to be applied for the whole year. It is now to be expected that a similar tonnage will be taken from Canada, in this case probably in the form of concentrates.

OFFICIAL TURNOVERS

Official turnovers (in l.tons) for the week ending August 18, with the previous week's figures in parentheses are :—

Copper	12,350	(10,0[illegible]5)
Tin	2,255	(9[illegible]0)
Lead	4,625	(7,6[illegible]5)
Zinc	4,325	(5,6[illegible]0)

Closing prices are as follows :

	August 17		August 2[illegible]	
	Buyers	*Seller*	*Buyers*	*Sell[illegible]*
COPPER				
Cash	£230½	£230¾	£229½	£2[illegible]
Three months ..	£233¼	£234	£233¼	£2[illegible]
Settlement ..	£230¾		£229¾	
LEAD				
Current ½ month	£64	£64¼	£64¼	£[illegible]
Three months ..	£65¼	£65½	£66¼	£[illegible]
TIN				
Cash	£942	£943	£960	£96[illegible]
Three months ..	£954	£955	£968½	£96[illegible]
Settlement ..	£943		£961	
ZINC				
Current ½ month	£76½	£77	£74¾	£[illegible]
Three months ..	£77⅛	£78	£75¾	£[illegible]

Mining Finance

The Harmony-Virginia-Merriespruit Deal in Retrospect

Looking back in retrospect at the land deal which involved three of the companies in the south-east corner of the O.F.S., it is interesting to follow the complaints of the shareholders and the lessons which emerged from the various discussions both at the meetings and in the court case.

The main complaints were raised by the shareholders of the Harmony mine, unquestionably the most prosperous of the mines involved, for it appeared to them that the transfer of some 397 claims of Harmony ground to the Virginia mine for R 6,000,000 was not in their best interests. Very little information about the proposed deal had been given in the circulars which convened meetings for May 4 in order to discuss the proposals, and it could be said that the shareholders won the first round when Harmony, Virginia and Merriespruit all issued further notices stating that these meetings "would not take place" and that further notices would be issued convening meetings at a later date.

The main spokesman for the shareholders was Mr. Joseph Milne, acting both for himself and various shareholding companies in which he is interested, and his attack was based on two points; that insufficient information had been given for shareholders to decide whether in fact the deal was in the interests of the shareholders and that insufficient disclosure of interests had been given. Were the directors, he asked, really independent directors acting on behalf of Harmony or were they employees of the large mining finance houses? On this latter point Mr. Milne was challenging the long established practice of the houses not to disclose their holdings, but he was doing so with the support of the South African Companies Amendment Act 1952 which requires that the notice convening a meeting to discuss a contract shall state the nature and extent of the directors' interest in that contract.

The next move came when it was disclosed at the Virginia annual meeting that Virginia had already taken occupation of part of the land in question and that R 600,000 had already been spent on the development there. It also appeared that Harmony was doing some work in the area at Virginia's expense.

In view of this disclosure it seemed to Mr. Milne that, though the transaction had not been ratified by the shareholders, the company was already carrying it out. The companies, however, maintained that they were entitled to do this work and it was left for Mr. Milne to take the matter to court if he so wished.

At this stage Mr. Milne's main motives in opposing the deal became evident, for he was prepared to withdraw his opposition if Harmony were admitted to the consortium, Virginia - Merriespruit Investments (Pty), which had acquired the Kennecott investment in Virginia and Merriespruit. His chances of success in this request were small and his opposition continued.

On June 10 the three companies each issued large circulars and notices for meetings on July 24, giving not only very full information regarding the actual transactions and the effect upon the individual companies but also the directors' interests and in turn the holdings of the mining houses. (See *The Mining Journal*, July 14.)

However, Mr. Milne was still not satisfied and in the hearing of the application by Candice Investments, one of Mr. Milne's interests, for an order of judicial management or an investigation into the affairs of Harmony, Mr. Margo appearing for Candice Investments said that his client was not alleging *mal fides* on the part of the directors; what his client wanted to know was the value of the asset that was to be sold to Virginia for R 6,000,000. In fact, the court dismissed the application, which had been made under Section 195 of the Companies Act and Section 95 *bis*, ruling that these sections only applied where there was mismanagement or financial instability, none of which applied in any way to Harmony.

At the Harmony meeting on July 24 Mr. Milne again asked that the shareholders should be allowed into the syndicate of mining houses that had taken over the Kennecott investment and called for an adjournment in order that the chairman, Mr. P. H. Anderson, might approach the syndicate again. In reply Mr. Anderson pointed out that Kennecott wanted guarantees for the R 7,000,000 that they were to be paid and that they were not joint guarantees. It was hardly likely that Kennecott would accept individual shareholders as guarantors, nor would any investor wish to buy shares with such a contingent liability, however remote it might be. It was decided not to adjourn the meeting and the proposed sale was subsequently endorsed.

Whilst it would be against all Stock Exchange requirements not to give information in advance of a meeting there appears to be no legal need for the board to do so. The law does, of course, provide remedies for the shareholder if he feels dissatisfied after the meeting, under the provisions specially made to protect the interests of an unfairly treated minority.

However, the detailed circulars issued by the companies still stand as a monument to Mr. Milne's efforts. As the law stands the mining houses are bound to disclose their interests in such cases and the detailed information given about the proposed deal stands, though perhaps not in the eyes of the law, as a fine example and precedent for all future occasions.

London Market Highlights

There was little stirring in the South African gold share market this week. On Wednesday, for example, business dwindled to a mere 106 bargains, about one-fifth of the turnover expected in moderately active conditions. But although there were few buyers there were equally few sellers and so prices did little more than occasionally ease a few pence here and there. West Driefontein, were duller than most and drifted 3s. 3d. to 78s. in the three days. "Ofsits" came back 2s. 4½d. to 59s. 6d. on some Continental offerings while Western Holdings eased 1s. 3d. to 118s. 9d. A firm exception was provided by New Wits which edged up 7½d. to 7s. 3d. on hopes of an increased final dividend.

Despite the troubled conditions in Northern Rhodesia the copper issues were considered to have behaved remarkably well. Prices were marked down by 1s. 6d. or so at the beginning of the week but they soon regained part of their losses on Wednesday when a modest investment inquiry disclosed the fact that the market was very short of shares. The reluctance of jobbers to allow short positions to grow on their books was accentuated by the feeling that the metal price has still to reflect the implications of the current nation-wide strike of Chilean producers, which at the time of writing has lasted a fortnight and still shows no sign of being settled. Nchanga ended with a net loss of 1s. at 46s. after having been 45s. 6d. and Rhokana were finally 1s. 3d. lower at 46s. 9d. There was no recovery in Bancroft, however, which being subjected to some selling from Switzerland and Brussels fell 10½d. to 12s. 7½d.

Tin shares were firm, but not so buoyant as might have been expected in view of the strong advance in the metal price. Prices were not helped by the fact that the Singapore market was on holiday on Tuesday, although a little business was done with that centre. Demand was selective and centred on such leading issues as Ayer Hitam which rose 2s. 6d. to 57s. 6d. and Sungei Besi, 2s. up at 51s. Gains of 1s. 3d. were seen in Gopeng at 48s. and Pengkalen at 16s. Tronoh started well with a jump of 1s. to 77s. 6d., but profit-takers immediately appeared and the shares were finally showing a net loss of 1s. at 75s. 6d.

London and Rhodesian became something of a two-day wonder. The shares of this land company suddenly came to life with a spurt of 1s. 4½d. to 9s. for no very obvious reason. Admittedly the interim dividend was due, but the subsequent announcement showed only a small increase and following the news the shares did no more than relinquish 6d. of their previous rise. Elsewhere, a cautiously worded circular from Central Provinces Manganese showed that at least some progress had been made in talks with the Indian government regarding the knotty question of lease renewals and thus heartened, the shares rallied 6d. to 14s. 9d.; earlier this year they had been up to 27s. 3d.

INVESTMENT IN SOUTH AFRICA—UNDER GUARANTEE

It is understood from South Africa that a scheme designed to attract foreign capital is under consideration by the authorities. It appears that the essence of the scheme is that, for a fairly substantial investment over a fixed period of say five years, the authorities would be prepared to guarantee repatriation. Undoubtedly such a scheme would have its attractions to the overseas investor for not only are the yields in South Africa fairly high but any substantial investment would almost automatically have a fair proportion in gold shares with the hedge against inflation.

This would not be a novel scheme for it has a precedent, though under somewhat different circumstances, in the agreement between the South African authorities and the American-South African Investment Company. When this company was established in 1958 with the declared intention of investing $30,000,000 in South Africa, it entered into an exchange guarantee arrangement with the S.A. Reserve Bank. This ar-

rangement which costs A.S.A.I.C. ¼ per cent per year specifically guarantees the return in dollars of the subscribed capital invested in South Africa. It was also agreed that income tax would not be charged on the capital profits if and when the shares were sold. In turn A.S.A.I.C. undertook not to repatriate its capital within five years. For investments of a similar size it appears that the government would be prepared to guarantee repatriation though it is not clear whether similar tax reliefs are being considered.

Whether this is likely to lead to the formation of investment trusts with the specific aim of attracting capital for investment in South Africa under guarantee conditions must depend upon the guarantees and concessions that are envisaged by the Republic government but it is certainly a scheme which has its possibilities.

GEEVOR—A BOLD DECISION

The future of the Geevor mine rests to a very large extent upon the development of its lodes to the west, out under the Atlantic Ocean. Recent development and borehole results have given promising indications but the limiting factor has been the demarcation line, laid down by H.M. Inspector of Mines, with reference to the old flooded Levant workings. Already the development on the North Lode (Footwall Branch), on levels 12, 13, and 14, is approaching this demarcation line.

As an answer to these problems Geevor has taken the bold decision to seal off the breach in the old "Forty" backs in the Levant workings and to dewater the mine. If this project is successful then the wide west is open for Geevor to develop and exploit. A team of young geologists from the Royal School of Mines, who have carried out an undersea geological survey on part of the Cornish coast (see *The Mining Journal*, August 18, 1961), have located the breach in the sea bottom connecting with the Levant workings and a team of diving experts from Reed & Mallik Ltd. have made a thorough examination of the breach and the surrounding sea bottom. The plan is to place a small concrete plug in the breach itself and then to pour a reinforced concrete mat which will cover the plug and the surrounding area.

Already the plug has been placed and at present the divers are cleaning off the growth on the rocks surrounding the breach and are placing the reinforcement in readiness for pouring the main mat. Work of this type is obviously very dependent upon the weather but it is hoped that at the meeting, to be held on September 13, the chairman, Mr. G. W. Simms, will be able to tell shareholders that the main mat has been poured and that this portion of the work is complete. The dewatering of the Levant mine can then commence; it is the intention first to lower the water to the 40 fathom level and secure the position within the mine further before attempting to dewater the mine to the bottom level. The actual pumping will be a considerable task but from the history of Levant it appears to have been a dry mine.

This work, together with the diamond drilling at Cligga discussed later, will call for heavy expenditure but an examination of the Geevor balance sheet, as at March 31, 1961, shows the company to be in a strong position. Taking quoted investments at market value and ignoring the value of stores on hand the net current assets amount to £346,027, and thus it should be possible to see this development work through to fruition without appropriating large sums from current profits.

The dividend this year has been maintained at 2s. 6d. which on the current price of 27s. gives a yield of 9.2 per cent. In the current financial year the production of tin is a little ahead of the previous year. For the first four months 228 tons of tin have been produced as compared with 217 tons for the same period in 1960. However, the average price received for tin to date this year has been considerably higher than in 1960 and this is particularly significant for Geevor as a fairly high cost producer.

DRILLING AT CLIGGA

Together with other mining interests, Geevor is at present carrying out a programme of exploration in certain areas of Cornwall. At Cligga a few diamond drill holes have been drilled to comparatively shallow depths and the results have been sufficiently encouraging to warrant further expenditure on exploration. It is planned that the exploration should be completed in a further two stages before any decision with regard to opening a mine will be considered. The next stage is estimated to cost £30,000 of which the Geevor share will be one quarter.

The success of this project must depend to a large degree upon the tin values encountered in the exploration work but it is also dependent upon the government's attitude towards taxation on a new mining enterprise. Mr. Simms has said that the government would again be approached with a view to reducing the impact of mining taxation on new mines and he thinks that there is reason to hope that in due course the government will take the necessary action.

GOLD FIELDS EXPAND IN AUSTRALIA

The Gold Fields group with the financial aid of the United States company, Cyprus Minies Limited, is to expand its Australian exploration programme. It has been announced that Consolidated Gold Fields (Australia), Gold Fields Mining and Industrial's wholly owned subsidiary, has entered into a joint venture agreement with the American company on a fifty-fifty basis for an initial period of at least three years. The Gold Fields companies will be responsible for the management and the implementation of the exploration programmes, the actual exploration being undertaken by New Consolidated Gold Fields (Australia). This company has been engaged in exploration in Australia since 1956.

This is not the first joint venture in Australia between Cyprus Mines and Gold Fields. Recently a similar venture was announced with the object of prospecting for iron ore in Western Australia, In the latter undertaking, however, there is a third partner, Utah Mining and Construction of San Francisco.

INCO HALF YEAR

The interim report of International Nickel shows that the net earnings for the first six months of 1961 are $37,653,000 compared with $43,902,000 for the same period of the previous year. This net earning figure is equivalent to $1.28 per common share. The fall in earnings is mainly the result of the lower deliveries of nickel in all forms during the period and also reflects the lower level of the selling price for copper. The outlook for the current six months is brighter with the United States steel industry looking forward to an increased activity this autumn.

After a period of over four years in which the price of nickel charged by Inco was kept at £600 per ton, the price has now been raised to £660. There have recently been hopes that, with the ending of the capital expenditure programme, the board would follow a more liberal dividend policy and the increase in metal price has intensified these hopes. Dividends of 40 cents per share were paid in March and June and a further dividend of 40 cents has been declared, payable on September 20. At present, the yield of only 1.8 per cent on the London mock dollar price of 151.3 discounts the expectation of improved distributions in the future.

President Brand.—Borehole S.P.9 on farm Stuirmanspan, situated 11,900 ft. south-south-east of No. 2 shaft on the extreme southern boundary of the mine has intersected the basal reef at 5,450 ft. The original intersection and the two subsequent deflections intersected a wide reef horizon but the gold assay in each case was poor. The equivalent value for the original intersection was 63 inch-dwt.; the deflections were equivalent to 71 and 54 inch-dwt.

President Steyn.—Two deflections have been made on the borehole K.P.12 situated 5,900 feet south of the No. 2 shaft. Both deflections were at a depth of 6,543 ft. The first assayed 10.6 dwt. over a width of 29 in., equivalent to 307 inch-dwt. whilst the second assayed 9.8 dwt. over 27 in., equivalent to 265 inch-dwt. The original intersection reported earlier gave values equivalent to 330 inch-dwt.

Mount Morgan Final.—The preliminary results show that the net profit for the year ended June 25, 1961 has fallen to £372,321 as compared with £425,712 for the year ended June 28, 1960. The directors have declared a final dividend of 9d. (Australian currency) per unit of stock, bringing the total payment for the year to 1s. 6d. against 2s. 0d. for the previous year.

Rio Tinto of Australia.—The directors have announced an interim dividend of 3d. per share payable on September 29, 1961.

The 123rd annual meeting of the British Association for the Advancement of Science is being held at Norwich from August 30 to September 6, 1961.

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A meeting, arranged by the Forschungsinstitut fuer Aufbereitung will take place on August 29 and 30 to discuss "The Preparation of Inorganic Non-Metallic Minerals", at the Research Institute for Mineral Dressing, Freiburg, Saxony.

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The American Society of Mechanical Engineers is holding an International Heat Transfer Conference from August 28 to September 1 at University of Colorado, Boulder, Colorado.